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MEETINGS OF PUBLIC COMPANIES.

A Series of Portraits
Men in the Mining
Investment World

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THE IDAHO GOLD AND SILVER MINES (LIMITED).

AN extraordinary general meeting of this company was held on Tuesday last at Winchester House, Old Broad Street, Mr. G. H. PERKS presiding.

The SECRETARY (Mr. W. J. Hammond) having read the notice convening the meeting,

The CHAIRMAN said: Gentlemen, in the unexpected absence of your Chairman, who was suddenly called abroad last week on important business, and the holidays having prevented the attendance of several other of your directors, I am placed in the position of having to take the chair to-day. I did not anticipate when I came up from the north yesterday to be present at this meeting that I should have to take the chair, but the business of to-day's meeting is really purely formal, viz., to confirm the resolutions which were almost unanimously passed at the last meeting of shareholders. At the former meeting your Chairman made a very long and exhaustive statement as to the position of the company, from the first contract for the conditional purchase of the mines down to the present time, when we have trouble and difficulty, when local mismanagement and deception have left us without funds, and our property in danger of being seized for debts which we never expected to exist. Gentlemen, at the last meeting you not only had the long and full explanation of the Chairman, but you had read to you the reports of Mr. Plummer and Mr. Milford, the latter gentleman being present in the room, and submitting himself to be questioned by the shareholders. I think there is nothing with regard to the statements then made which requires further comment from me, but as one of the original directors of the company, I cannot allow this opportunity to pass without saying something in reference to ourselves. There may have been, in fact, there has been, mismanagement in Idaho; there may have been over confidence in London in the value of the company's property, induced by the wonderful reports sent over to us, but the directors, at any rate, were all business men, and they gave as much care and attention to the business of the company as if it had been their own business, and what is more, gentlemen, they backed their management and their confidence with their own money, and the money of their nearest relations and most intimate friends. It is a fact that nearly every share originally taken in this company was taken by the directors, and their relatives and friends, and it was not until after the report of the specially selected expert, and when the statements of accredited Americans were confirmed by an Englishman of known position, that outsiders were asked to come into this matter. Some shareholders at the last meeting asked questions as to the liability of the directors in respect of certain statements in the prospectus. I challenge any shareholder of this company to show that we, your old directors, ever made any statement otherwise than perfectly honest and *bona fide*, or that we ever acted with regard to the management of the company otherwise than with a sincere and earnest desire to do our very best in your interests, which were in the interests of ourselves also. I will not say more upon this. Our challenge is made, and we are ready to meet anyone who thinks fit to take it up. Gentlemen, we have no further information as to the company's position to give you than that already furnished. The debts are variously estimated at from \$20,000 to \$30,000—from 4000l. to 6000l. It is not proposed to pay all these at once, but only to pay such of them as it may be absolutely necessary to pay in order to get to work on the property, and test the vein of orespoken of by Messrs. Plummer and Milford as existing in the overland workings. If that should prove to be of value you will still have a mine, and without any great expense could develop it thoroughly, while your mill is capable of treating large quantities of ore. If the vein of ore referred to does not turn out to be of value in depth, then only the smallest possible sum will be called up out of the 3s. paid on the shares of the intended new company. I may state that we have proxies which represent 106,440 shares, so that the resolutions are certain to be confirmed, and under these circumstances, whilst we shall be pleased to answer any reasonable questions, and to allow the resolutions to be reasonably debated, I do not think it would be right that the time of the meeting should on this occasion be taken up with a discussion of the discursive nature of that which we had last time we met. Gentlemen, I beg to move, in the terms of the notice convening the meeting, that the resolutions 1, 2, 3, and 4 be, and they are hereby, severally and respectively confirmed, viz.:—

Mr. TARN said Dr in the room what in because there was in the office. With regret at the last general n showed that the dire It was not true that ever had stood in sold by the director vanced to the compa he first joined the l own pocket. Dr. Jo simply to create pr came from the mine Jones knew it.

The CHAIRMAN sa They had never rec the company was s undertaken a certain holders, for which t sold shares at a profi have said that Dr. Jo

The resolution was Mr. MILFORD, m that when he visits much better than t pieces of quartz cont that they should sir whether they had no because they had r leave it now would A vote of thanks w of Mr. WRIGHT and

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The SECRETARY (meeting.

The CHAIRMAN sa appearance there as (F. Retallio, had hel man had decided not directors had done h chair. He would en as possible the reas remembered that up tory meeting. In the a shareholders' meeti have been present; which the directors l the meeting had beer able to the sharehol the statutory meetin to what the compa They would reme fully reported upon that it was a propert which anyone might money. He did not alter their opinion sin report from Mr. Stru field now known thro due time the board who was conducting was a man of large got from the property body who had seen th had been carried out the shareholders not rose to a consid Rowe decide osity for d

ness knew more than any other shareholder nation had been received by the directors, only a day in the week that he did not visit to his unworthy charge against the directors. A balance-sheet was submitted, which had advanced to the company 22,000*l.* Mr. Thorne had sold a share; every share he had sold now. Some shares were, however, not to realise some of the money which they advanced and not one single director from the time that he had sold a share and put a penny in his pocket, and he raised the question thereupon. With regard to the telegram which the directors bought shares upon it, and Dr.

the directors had been the greatest sufferers. It had cost so much as a penny piece from the time led to the present moment, and they had incurred a great amount of liabilities on behalf of the shareholders, and stood liable at that moment. If they had not put premiums in their pockets, they should have been justified in having suspicions. The directors then put and carried unanimously. The expert, stated in answer to questions that he had opened up places which looked like silver. Captain Plummer and he agreed to put down upon that part of the property and see if there was any good lode there. It was well worth a trial, and they were to try silver, water courses, &c., on the spot. To do this was suicidal. The directors then seconded the Chairman on the motion and the proceedings terminated.

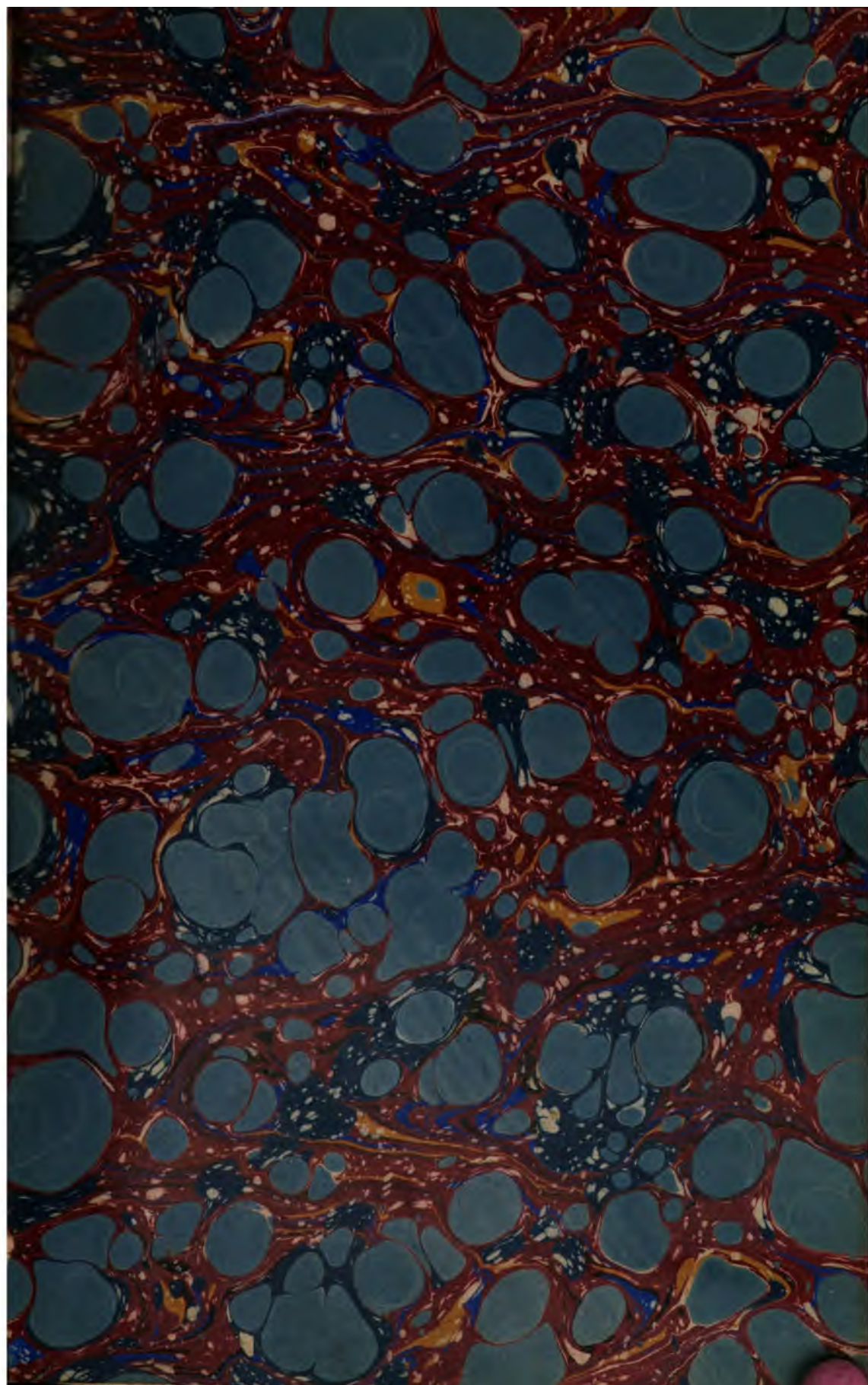
JIS GOLD MINING COMPANY (LIMITED).

Meeting.—The cost of labour—Issue of further capital.

General meeting of the shareholders of the company (Limited) was held at the City Hotel, 11, Abchurch-lane, E.C., on Wednesday, August 8, 1889. J. W. JOHNS presiding. H. Ward read the notice convening the

meeting. He would like to explain the reason of his coming to the meeting that day, a post which his friend, Mr. Ward, had put to the present time, but as that gentleman had become a member of the new board, the honour of placing him in the chair (Mr. Johns) the honour of placing him in the chair to place before the meeting as shortly that meeting had been called. It would be the present time they had only had a statutory course of events they would have had in October next, when the accounts would be put to them, but in consequence of the scheme to bring before the shareholders that day, and to be agreed at an early date, and it might be agreed, especially to new ones, who were not at all if he were to give them some particulars as had been doing since its incorporation. He said that this property was very carefully managed by Messrs. J. Taylor and Sons, who decided of very great importance, and a property in which they had invested who sought a good return for their money. Those gentlemen had had any reason to do so. The directors also had a very important person, who was the discoverer of the great gold mine about the world as the Randt formation. In fact, the manager in the person of Mr. Rowe, was at the mine at the present time. He had seen, and although the directors had not seen the important crushings they expected, every-thing had stated that the mining operations were in a manner second to none in the district. If he plan they would observe that the land had been bought and then sunk to a very low point. Mr. Ward then there in consequence of the need to get it also to get very quickly to work on it that, he believed, was the reason

and recently he (the speaker) had seen a very admirable letter from Messrs. Quentin and Tarbutt, who were also supposed to have some knowledge of the Randt, and this peculiar formation in particular. Well, all these gentlemen agreed as to the immense importance of this banket formation: there is no one adverse opinion; not one sounded a false note of any sort of disappointment, or gave a despairing cry as to the value of this property. Coming to the future, the Chairman said the present scheme was a very simple one. He would tell them why it was necessary. It was necessary because the wages and the freight accounts from the other side had been more than double that what they were estimated at. Instead of giving 1*l.* a month for labour they had been compelled to give 3*l.* The position was that all their capital was gone, and they had only accomplished only half the development they ought to have accomplished. They had, therefore, called together a few of the shareholders, and explained the position to them. He was happy to say they came forward without a moment's hesitation, and offered to give them 60,000*l.* for 12 months upon certain terms. Those terms were that 6 per cent. interest and a bonus was to be paid. He had never in his life met such a thing in any company, and he thought they ought to congratulate themselves upon having such a strong body of shareholders who did not sell their shares but who were holding them, and who believed that the time would shortly arrive when the shares would be higher than they had ever been before. (Applause.) Briefly the scheme was this. If the agreement was carried out before the 31st of this month within three weeks of that time they would raise subscriptions at par for 60,000*l.* of debentures at 6 per cent. interest which was to be secured by a trust deed. The gentlemen who were lending the money said that the directors had not managed the affairs of the company up to the present time in a satisfactory manner. Well he hoped after the statement he had made that day they would be inclined to say "as far as the board are concerned they have done everything they could do in very difficult circumstances." At any rate the lenders had stipulated that they should see to the proper expenditure of this 60,000*l.* He might tell them that 15,000*l.* of that sum would go in the purchase of the freehold farm upon which their property was situated. That farm contained a great many other mines besides our own, and is at the present moment bringing in an income of 3000*l.* a year. Amongst the advantages of the proposed purchase the Chairman instanced that no one could then interfere with their water rights, or could do what was termed jumping. Coming again to the terms of the agreement Mr. Johns said the loan was to be paid off in cash with a bonus of 15,000*l.* by the 1st August of next year with the interest. The shareholders were to be asked to-day to create 100,000 new shares. Those shares were not to be issued until August of next year, and therefore he was afraid that if any "bears" had been dealing in this property and selling shares with the expectation that the 100,000 shares would come upon the market at an early date they would be very much disappointed to find that they would not be issued until August of 1890. The only object for the shares being created now was that when August of next year arrived the lenders, in default of the company paying back the 60,000*l.* and the 15,000*l.* bonus, would then have the option of taking that 75,000*l.* at par, and a further option of taking the 25,000 shares by giving the company 25,000*l.* in cash. In other words, if they did not pay the lenders in a year's time, they would have the power of taking this 100,000 shares by paying the company 85,000*l.* sterling. He asserts again that was a magnificent proposition for this company. (Hear.) The company was never in such a strong position as at this moment. It had never had such a chance of being the mine which it ought to be, and which he believed it would be. (Hear.) The gentlemen who had made the offer in the present case were no ordinary individuals who they could pick up in the City of London every day, and this would be understood when he mentioned the names of Sir Donald Currie—(applause)—and Mr. Struben, the discoverer of this great formation; and, indeed, they were all men who knew the property, and the value of the Randt and the mines there, and they might depend upon it that as good a proposition as this was for the shareholders of the company it was a very good proposition for the capitalists too. (Hear, hear.) Supposing they looked at the other side of the picture, and supposing the company paid the capitalists back in 12 months the 60,000*l.*, and if they would permit them their bonus as well, then they would only have the right to take 40,000*l.* of that 100,000*l.* at par, and the balance of 60,000*l.* the directors had a right to offer to the shareholders at par or at whatever price might be fixed upon at that time. (Hear.) He thought they would not say the directors had made a bad bargain for the shareholders, bearing in mind that when the time arrived (August, 1890) that would not be the end of their tether, because they would have a further six months' notice which practically made it eighteen months from this time in which to raise this money, and in which to pay the lenders off. He dared say they would be very glad if the



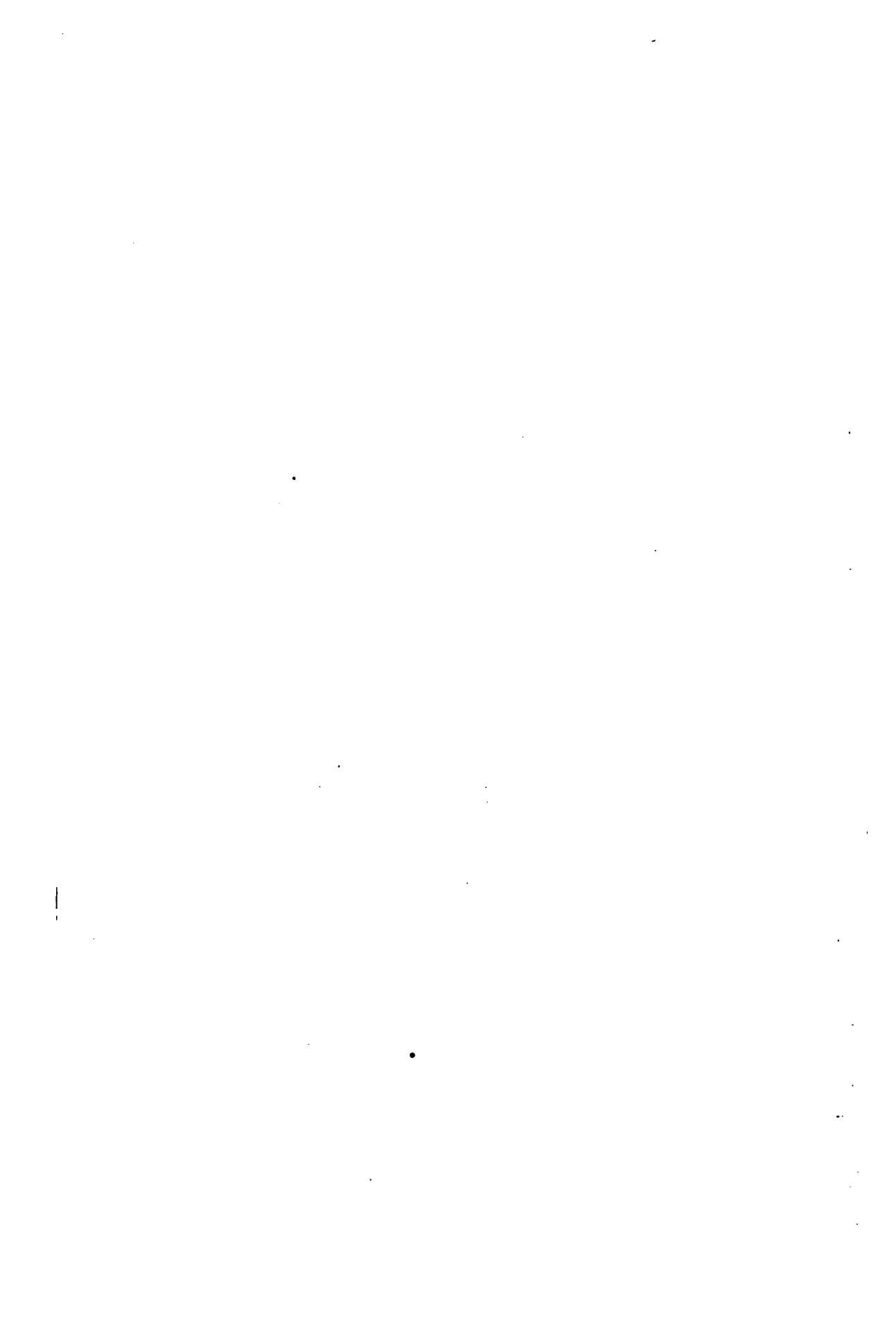
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ARTS, MANUFACTURES, AND COMMERCE.

CANTOR LECTURES

ON

ALLOYS USED FOR COINAGE.

BY

W. CHANDLER ROBERTS, F.R.S.

DELIVERED BEFORE THE SOCIETY OF ARTS, MARCH 17, 24, 31, AND APRIL 7, 1884.

LONDON:

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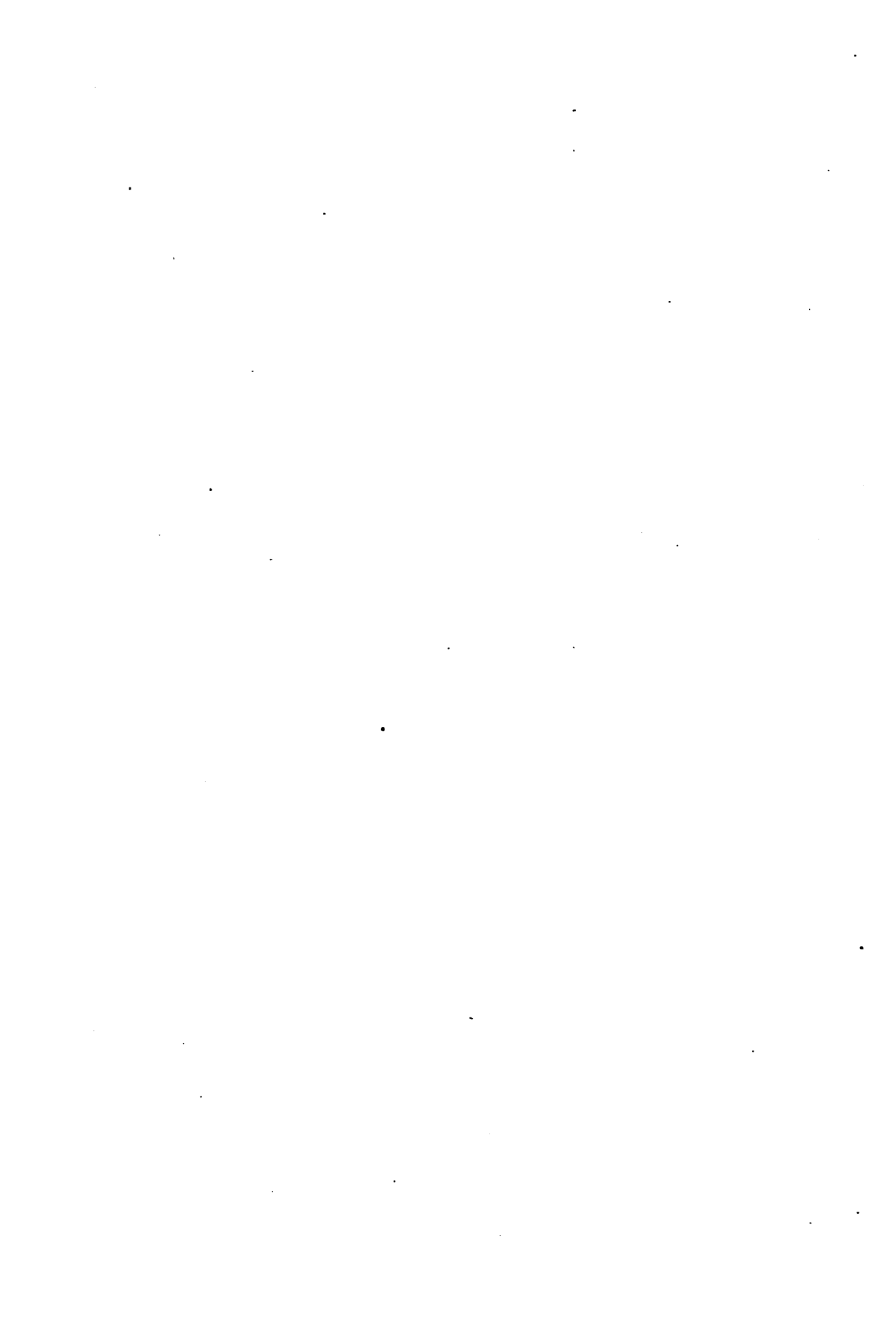
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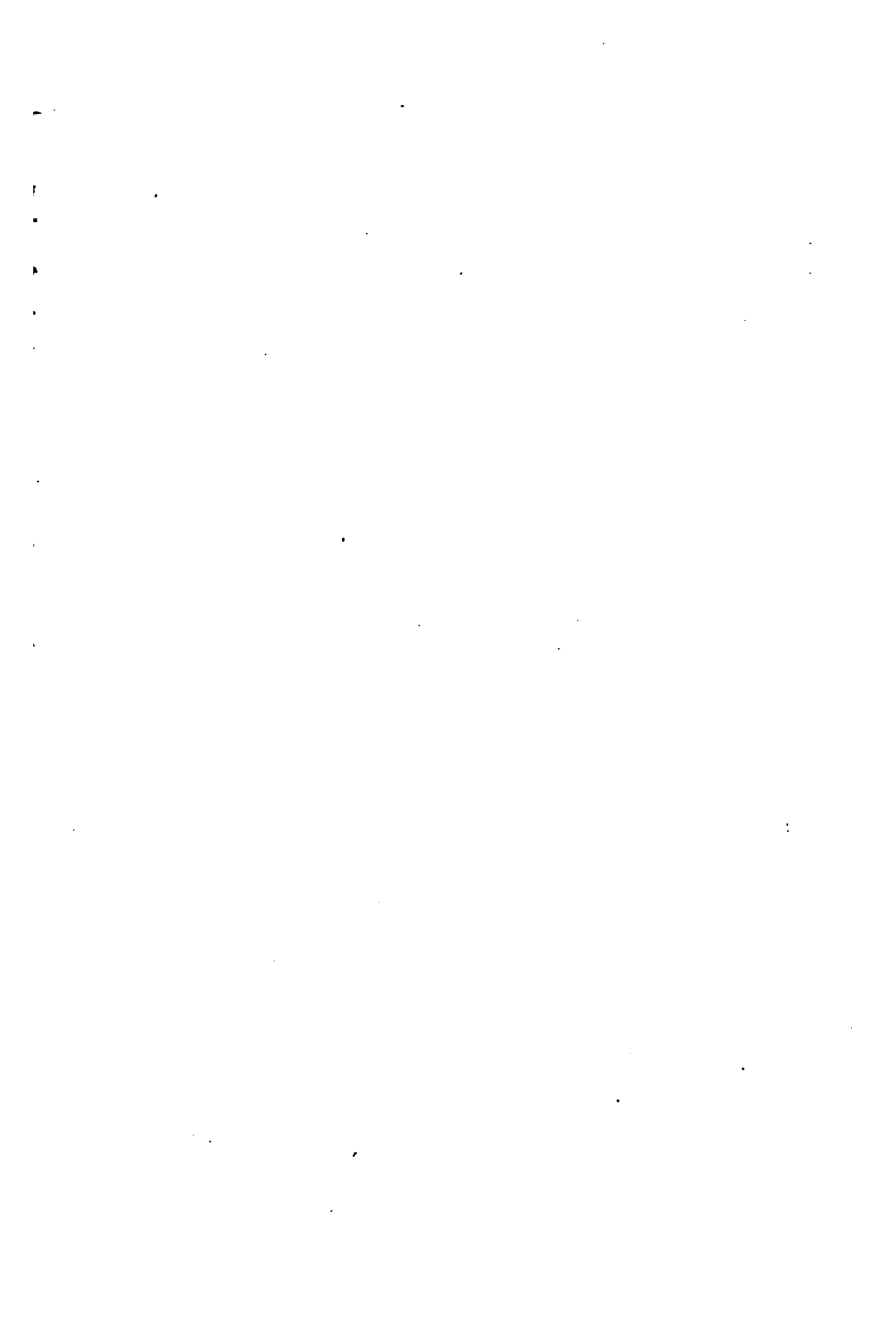
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“ Come avanti v'ho detto lega altro in questo luochò non vuol dire che mescolamento damicabile amicitia lun metallo con laltro.”

BIRINGUCCIO, 1540.

“ But it was speedily found out and discovered that weight alone was not a sufficient measure for gold and silver, by reason that they are subject to mixture, and therefore there was an examination made of the pureness of them, and a mark impressed upon them to show that they were approved.”

RICE VAUGHAN, 1675.





ALLOYS USED FOR COINAGE.

LECTURE I.—DELIVERED MONDAY, MARCH 17, 1884.

At a very critical period of the history of the alloys used for coinage, one of the earliest of the English political economists, William Stafford, dedicated a little work to Queen Elizabeth, in which, under the form of a dialogue sustained by a knight, a doctor, and a merchant, he shows a keen appreciation of the conditions which a metallic currency has to meet.

The doctor complains of the base alloys circulated as coin in the previous reign, to which the knight (who tells us incidentally that he "was once in Parliament") replies:—"Forsooth, and such a dullard am I indeed, yt I cannot perceave what hinderance it should be to the realm to have this metal more than that for our coyne, seeing the coyne is but a token to goe from man to man when it is stricken with the prince's seale. . . . If ye prayse the gold for his weight and pliableness, led [lead] doth excel it in these pointes; if ye commend his colour, silver bye many men's judgement passeth him." The doctor then enters on an eloquent defence of the use of the precious metals for coinage, and sets forth what he calls "a brieve conceipte of English pollicye" with regard to currency.*

At the present day, preference for one metal more than another, or for the simultaneous use of two metals, as standards of value, is widely and forcibly expressed; but although it is generally known that neither sovereigns nor shillings are made of pure gold or pure silver, few people have very definite ideas as to the composition of the alloys which are employed in coinage, and still fewer are aware that the amount of base metal added to the precious one is guarded with the most rigorous care. As showing the national importance of the subject, it may be mentioned that between 700 and 800 tons of the alloy of gold and

copper constitute the gold coinage of this country.

There is a great difficulty in tracing, chronologically and in detail, the history of the mechanical side of the art of coining, because its progress has been by no means continuous. Certain types of machines have survived persistently in some countries, and have been abandoned in others often to be again introduced with or without modification. A good illustration of this difficulty is presented by the fact that the method of coinage practised in this country under the Plantagenet kings is still met with in native mints in India; and, conversely, a machine—the *mouton*—used for striking coins in France and Italy, and abandoned centuries ago, is now employed in Birmingham, and in the Mint of this country, in the preparation of medal clasps. Again, the screw-press, invented in the 14th century, and long used for coining, is employed for striking medals in all mints in almost its primitive form; while a machine the action of which depends on a very different principle, is as universally adopted for striking coins.

It is safe, however, to conclude that while in civilised countries, at least since the 13th century, the designs of coins have always fairly represented the general artistic culture of the periods at which they were struck, the appliances used in their manufacture have, at times, been distinctly behind the mechanical science of their days, as indicated in other technical arts. For the last fifty years, until the year 1882, the Mint in this country presented a striking example of this, as its machinery was admitted to be antiquated, while the general progress of mechanical science, during the same period, was probably greater than at any other time.

Further, there can be no doubt that, viewed from a modern standpoint, there have been periods during which the work of the metallur-

* London, 1581.

gist—in the purification of precious metals, in alloying them, and in verifying their “standards”—has been greatly in advance of that of the artist who engraved the dies, or of the mechanic who struck the coins.

The historian of the coinage of Great Britain begins his great work* by stating that “in the most early stage of society, when the wants of man were confined to the absolute necessities of life, barter may be sufficient for every purpose of exchange. But this is a point at which society cannot long remain fixed; and the first step towards civilisation introduces a train of wants that will require a more perfect medium of commerce; something which, by general consent, shall be received at a determinate value, in exchange for all other things.” The problem is, however, by no means a simple one, and it is usual, in even the most elementary works, to give examples of articles, such as fruits, shells, and skins, which have been used in abortive attempts to find this common medium of exchange, under the adverse circumstances of imperfect civilisation.

M. Boucher de Perthes held that prehistoric stone implements were among the earliest mediums of exchange, a suggestion which Jevons considers not improbable. Metallic implements certainly would meet many of the necessary conditions of money. Even with regard to metals, I may remind you that Artemus Ward felt he must refuse the coffin-plates† and door-knockers offered him for admission to his lecture, for, although these were metallic, fairly portable, and may even have borne engraved devices, they did not meet the necessary condition of being universally acceptable.

The circulation of gold and silver by weight approached nearest to the convenience of coins; but even this method was open to the objection that the masses of metal bore no external evidence of their value, and, therefore, much time had to be devoted to weighing or assaying them, and these difficulties were not removed until coined money was devised, the stamp being an authoritative indication of its weight, standard, and value.

The commodity for exchange must be in such general use as to ensure the certainty of its being readily acceptable, and further, as Nicolas Oresme pointed out in the 14th century, it must be of value, *materia preciosa*

* “Annals of the Coinage,” by the Rev. Rogers Ruding. 3rd edition, 1840.

† “Travels.” English ed., p. 98.

et cara; * or as a later writer, Rice Vaughan said in 1675, money should be made of a material which is not too common, “something not easy to be consumed with use, or spoiled for want of use.” Further, it must be portable. † “I confesse” (said William Stafford), “precious stones do excell siluer, or yet golde as in value or lightness of carriage, but then, they may not be deuided without injury, nor yet put agayne together after they be once deuided.” ‡

The quality of being easily divided is very important. “The tailor,” says Jevons, as we are reminded in several treatises on political economy, “may have a coat ready to exchange, but it much exceeds the value of the bread which he wishes to get from the baker. He cannot cut the coat up without destroying the value of his handiwork.”

That is no reason, however, why articles of clothing most needed should not be represented by metallic symbols, as was actually done in a very early form of Chinese money, which was not struck but cast. These curious coins are said to go back four thousand one hundred years, and to have been made certainly in the time of Yaou B.C., 2356.§ The coin from the Mint collection (of which a drawing was provided), represents a Chinese shirt, and, in fact, pieces of cloth, or these metallic equivalents, were used, as Sir John Lubbock has pointed out, “in some measure, as a standard of value, almost as grey shirting is even now.” ¶

Lenormant, speaking of Roman coins, considers that casting did not precede striking, and, quoting Mommsen, he points out that the Romans adopted the method of casting for the sake of cheapness and speed. ¶ Information respecting the details of the method of casting will be found in papers published in the *Numismatic Chronicle*, from which it appears that, “under the reigns of the Cæsars, Constans, and Constantius, there were cast, in a mint established at Bibé, large quantities of money with the stamp of the emperors who had reigned from Caracalla to

* “Traictie des Monnoies, de Nichole Oresme,” about 1370; reprinted with elaborate notes, by M. L. Wolowski. Paris: 1864.

† “Discourse of Coins and Coinage,” by Rice Vaughan, Esq., p. 2. 1675.

‡ “A briefe conceipte of English Pollicye,” p. 29. London: 1581.

§ Trans. China Branch of the Royal Asiatic Society, Part II., 1848-50, p. 1.

¶ *Nineteenth Century*, No. 33, p. 789, November, 1879.

¶ Lenormant, “La Monnaie dans l’antiquité,” Paris, 1878, t. 1., p. 274.



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JULIO PIPPI, called ROMANO.

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Postumus, and that this manufactory did not belong to forgers, but was for the imperial money, copper money being struck with the die of the reigning emperors, and the silver money of the ancient Cæsars, still more adulterated than the original pieces, being reproduced by founding."*

With reference to the casting of money, I may add that, until the close of the 15th century, the beautiful medals, such as those of Giulio Romano, were all cast in fine sand moulds, and not struck, and that the use of cast money was revived in Europe in the year 1791, when a coinage of bell metal was cast in France under the following circumstances:—In that year the bells of certain churches, which had been suppressed by order of the National Assembly, were ordered to be converted into coin. M. l'Abbé Rochon suggested that these should be cast in sand and not struck, and he pointed out, in an official report, that a "skilful moulder could easily cast 2,400 pieces in a day.† M. Dumas states that this bell metal was of two kinds; one variety, containing 20 to 22 per cent. of white metals, was cast directly into coins in sand moulds; and the other, containing only 10 to 12 per cent. of metals other than copper, was cast into strips of metal of the right thickness for cutting into discs without rolling. Over 19,000,000 francs' worth of these bell metal coins were subsequently converted into the bronze coins now circulating in France.‡

The early Greek coins, from an artistic point of view, present but little evidence of mechanical skill other than that involved in engraving the dies; but I purpose, before dealing with the alloys used for coinage, to trace the gradual development of the mechanical processes of coining from these earliest types until the introduction of the machinery now in use. It will not be necessary to deal with the existing appliances, as they have recently been fully described,§ and because they can be seen in operation at any time in the Mint. I shall, however, subsequently allude to the balances by which the weight and fineness of the coins is ascertained.

To return to the older methods. Nuggets, either of electrum or gold, presented a more or less convenient shape for direct conversion of coin, but if the precious metal had first to be

melted as a preliminary stage of its conversion, then some kind of moulding was necessary. In the early days, a globular form seems to have been given to the precious metal, by allowing it to fall in a molten state, through orifices so as to produce globular shot. These were placed on an anvil, and received a blow which served to flatten them, and at the same time to impress a device from an engraved die on their surface. Unstruck globules of the kind described have been found, lying with finished coin, at Reculver, in Kent.

As soon as the stamping of irregularly shaped portions of metal gave place to coins of rough, but more or less regular form, certain mechanical devices had to be adopted. First, the portion of metal to be converted into coin had to be fashioned by moulding into shape, either of a disc or a hemispherical mass. When the latter form was adopted, the device appeared on one side in high relief, and on the other in low relief. In either case the metal was probably cast into a shape approximating to that of the finished coin, and the more prominent features of the relief were given to the disc by casting. The early dies were made of an alloy of copper and tin. Such alloys are capable of being made of great hardness, but there is abundant evidence to show that the blanks were often, if not always, struck hot; and mechanically speaking, coinage must have been a very imperfect art before hardening steel was well understood.

The Roman dies were shaped like a sugar-loaf, and the flat bases bearing the engraved devices were of the diameter of the pieces to be struck. Both the obverse and reverse dies were sunk in metallic cylinders, the diameters of which were considerably larger than the dies. The lower cylinder bore a kind of rim which did not in any way restrain the lateral spreading of the metal to be struck, but prevented its ejection if the blow was incorrectly imparted to the upper die.

We owe descriptions of these very early methods of coining to M. l'Abbé Barthélemy,* a well-known antiquary of the last century, and to M. Mongez†, who repeated what were believed to be the ancient methods of producing dies and striking coins, and showed that the entire process might be performed with great rapidity.

It is probable that the use of cast globules of metal was followed by that of cast cylindrical rods of approximately the diameter of the

* *Numismatic Chronicle*, p. 147, et seq., vol. i., 1838-9.

† *Apperçu Présenté au Comité des Monnoies*, p. 17.

‡ Dumas, "Notes sur l'émission en France des monnaies décimales de bronze," Paris, 1868, p. 55.

"*Racy. Brit.*" 9th Ed., Article Mint, 1883.

* *Mém. de l'Académie des Inscriptions*, t. xxiii, and xxiv.

† *Ibid.*, nouv. sér., t. ix, p. 208.

coins; pieces cut transversely from these cylinders would, of course, be circular, and could be easily adjusted in weight. There is no reason to believe that this method long survived in the English Mints, but it is still practised in India, into which country it was probably introduced previous to the invasion by the Greeks. The beautiful coins of the Emperor Akbar were struck by this method*. That it is still retained in India is shown by the following description of the process, as conducted at the Cabul Mint.† “Silver, refined by cupellation, is melted with an equal amount of English rupees, and the mixture is ladled by hand into moulds, which give it the shape of flattened bars, twelve inches long. These bars are taken to a shed to be annealed, and are, by hammering, given the form of slender round rods. These rods are drawn through a perforated iron plate, to give them a uniform circumference, after which they are cut by a chisel into short lengths or slices, of a size requisite to form the future rupee, each of which slices is carefully weighed. Those which are too light have a fragment of metal inserted in a notch, which is then closed up by hammering. The pieces are gently heated, and hammered into round blanks, which are pickled in a boiling solution of apricot juice and salt, then struck by the blow of a hammer from engraved dies.”

The coins of Edward I. of England were produced by a similar process, but in this case the bars were probably square,‡ and the square fragments cut off were forged round with the tongs and hammer before being struck. This process was used from time to time in England, up to as late a period as 1561.

The primitive method of preparing “blanks” for coinage survived in Germany, even to the middle of the 18th century, and is thus described by Jars,§ who saw it in operation in the mint at Zellerfeld, in the Hartz, and I quote his description because the method of conducting the preliminary casting of the bars for coinage is interesting, as it differs essentially from the methods then in use elsewhere which involved casting the bars in moulds of sand or of iron.

“All the silver produced by the Communion district, even that from Upper Hartz, is brought to Zellerfeld to be converted into coins. An old coining method has been preserved in that

town. The silver, after being melted in a crucible, is poured on a band (made of a kind of ‘duck’ or cross-woven tissue) fixed at each end, on a kind of bow, which can be stretched at will by means of a screw and nut. The tension of the stuff, and the mode of its attachment, form a rim on each side. The bands are more or less wide, according to the size of the coins; but only ingots destined to make coins from the smallest size, up to florin pieces, are poured on it; the two-florin pieces are cast in sand. Care is taken that all the ingots should be much narrower, and therefore thicker than the coins. A workman holds this kind of bow above a small vessel filled with water, in which he dips the band, whilst another workman pours on it the silver, the tissue being still damp. The former agitates it gently before the metal is set, in order that it should be equally spread in all directions. Afterwards, he dips the metal into the water, and causes it to drop to the bottom of the vessel, otherwise it would burn the band. Fresh silver is poured, and the operation is repeated in the same manner.” (A variety of commercial copper, which was formerly highly esteemed, was cast in canvas furrows or moulds, under water, much in the way Jars describes in the case of the silver bars or ingots.)

The cast metal is then cut into square pieces, and these are rounded into blanks by the hammer, and the coinage is effected by the obsolete hammer method already described.

After the abandonment of the method involving the use of cylindrical rods, the early coins that were prepared by purely mechanical means, as distinguished from casting coins, were cut into discs from sheets or strips of either pure metals or alloys, by means of shears. The metal or alloy was beaten into a sheet or strip by means of the hammer, as is shown in a well-known engraving of the 14th century; the method was retained in France as late even as the year 1553, when the system of rolling the metal into sheets, attributed to Antoine Brucher, was introduced*. The invention of rolls was, however, much more ancient, and although they do not appear to have been previously used in minting, they were probably employed in very early times for laminating metals and alloys; but little is known as to the exact forms given to rolls used in mints before the introduction of Briot’s machines into the Scotch Mint. These, however, are described by Sir James Hope, in 1639, as being

* Figured Eighth Annual Report of the Mint, 1877.

† Abridged from an account given in the *Times*, Sept. 10th, 1880.

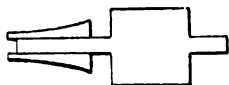
‡ Red-book of the Exchequer, quoted by Leake, p. 76.

§ “*Voyages Métallurgiques*,” t. 3, p. 252. Paris, 1781.

* Dumas, loc. cit., p. 29.

"rollers of yrne for drawing of mettels into length and thinness, standing in the turneing loome,"* and in a marginal note he shows that they were of this form, Fig. 1. Horse-power

FIG. 1



The projection on the left suggests the method of gearing.

was used for driving the rolls from a very early date, and it is perhaps worth noting that, in 1661, King Charles II. gave authority for the gold bars to be removed from the mint in the Tower to an adjacent building at St. Katherine's, in order that the "plates might be passed" through rolls attached to a water-mill.† With regard to the dimensions of the rolls, it may safely be stated that they were much smaller than those now in use.

Boizard describes the laminating mill used in the Paris Mint in 1692,‡ as consisting of two cylinders about four inches in diameter, keyed on to a driving rod of square iron, and turned by the wheels of a mill driven by horses, and he adds that the distance between the rolls could be adjusted by nuts and screws.

Probably but little change was made for a century after the above was written, for a description by Mr. Alchorne,§ Assay Master of the Mint in this country, in the reign of King George III., shows the general arrangement of the rolling-room in the Paris Mint towards the end of the last century, and incidentally indicates the nature of the London rolling mill. He says, "the bars are brought to a proper thickness by being passed several times between steel rollers, as in England. The rollers are turned by millwork, with horses as in London; viz., one large pair of rollers in the centre, and four smaller pairs at the four corners, if they may be called so. The central rollers are turned by the axes of secondary wheels, as in England; the rest by other wheels which are turned by these secondaries. The middle rollers both turn on the same level, so that the bars pass between them in a perpendicular direction, the other rollers turn one above the other as in England, so that the bars pass between them horizontally.

* "Hopetown Papers," quoted by R. W. Cochran-Patrick "Records of the Coinage of Scotland," vol. 1., p. lix. 1876."

† Mint Record Book, vol. 4, p. 26.

‡ "Traité des Monnoyes, 1692," p. 133.

§ MS. in Mint library, "Observations on the Coins and Coinage of France and Flanders."

The central rollers are considerably stronger and larger than the rest, and these are used for bringing the bars to a moderate thickness; after which they are properly reduced by the smaller rolls. The same mills are employed for both gold and silver, and four sets of them are placed in one range. Each set is worked by four horses, when the five pairs of rollers are used at the same time, and thus sixteen horses may work together under the same roof." I will only add that in the Mint, as re-organised in 1882, there are twelve pairs of rolls, the diameters of which vary from ten to fourteen inches, and that these are driven by an engine of sixty nominal horse-power.

It will be evident that the weight of the finished coin depends upon the thickness of the fillets; and to show how accurately the rolling must be performed in modern mints, it may be pointed out that, in the case of the half-sovereign, a variation of $\frac{1}{10000}$ th of an inch above or below the accurate thickness, or a range of $\frac{1}{10000}$ th of an inch, throws the coin out of the limits of weight within which its issue to the public could be permitted.

We may now pass to the preparation of the discs or blanks, and it is certain that whether the sheets of metal were prepared by hammering or by rolling, discs were originally cut from them by means of shears.

Lenormant,* quoting Hennin, considers that there is evidence of the use of circular cutters in early Egyptian times, but the adoption, in more modern times, of a cutter producing circular discs has been attributed to Aubin Olivier, who effected considerable improvements in the Paris Mint in 1553. Recent investigations have shown that the origin of the disc cutter was somewhat earlier, as its use was undoubtedly suggested by Leonardo da Vinci, the grandeur of whose genius has long been recognised, and the recent publication of whose literary works† has placed at our disposal a store of facts from which an estimate may be formed of his labours in specific branches of science. He is supposed to have designed the coins of Louis XII., King of France and Duke of Milan‡ in the time of Pope Leo X. He must, as Dr. Richter shows, have spent at least a year (1513-15) in the Roman Mint, where he cannot fail to have been struck with the crude ap-

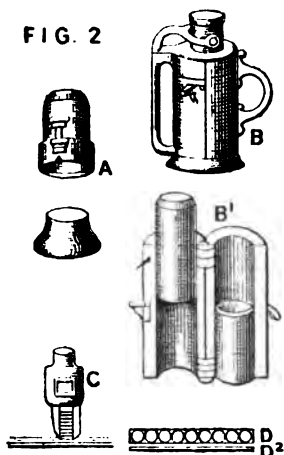
* "La Monnaie dans l'antiquité," t. i., p. 264. Paris: 1878.

† "The Literary Works of Leonardo da Vinci," compiled from his original manuscripts by Dr. Jean Paul Richter. London: 1883.

‡ "Art Applied to Industry." By W. Burgess (1865), p. 68.

pliances and methods of coinage then in use. In a note-book that can be proved to have been used in Rome, he says:—"All coins which do not have the rim complete are not to be accepted as good; and to secure the perfection of their rim it is requisite that, in the first place, all the coins should be a perfect circle; and to do this, a coin must, before all, be made perfect in weight, size, and thickness. Therefore, have several plates of metal made of the same size and thickness, all drawn through the same guage so as to come out in strips, and out of these strips you will stamp the coins [*i.e.*, cut the blanks] quite round as sieves are made for sorting chestnuts; and these coins [*i.e.* blanks] can then be stamped. The hollow of the die [cutter] must be uniformly wider than the lower [part of it], but imperceptibly so. This cuts the coins perfectly round, and of the exact thickness and weight, and saves the man who cuts and weighs, and the man who makes the coins round. Hence it [the blank] passes only through the hands of the gauger and the stamper, and the coins are very superior."*

The appliances devised by Da Vinci are shown in Fig. 2, and it is hardly necessary to



A, collar and dies; B, pair of dies in collar; B', the same, open; C, cutter; D, D', strip of metal after removal of discs by the cutter, C.

point out what a great advance upon the methods in use in the 16th century they indicated.

Fortunately, his countryman and contemporary, Biringuccio, the author of almost the earliest elaborate treatise on metallurgy we possess, devoted a chapter of his work to "a discourse, and advice on working a mint properly and profitably."† He

* Richter, vol. ii., par. 726, p. 18.

† De la Pirotechnia, p. 132, Venice, 1540, or French translation, Rouen, 1627, p. 197.

distinctly says that the alloy of precious metals is to be cast, beaten out with the hammer, cut in square pieces and rounded.

Da Vinci's instrument for cutting blanks differed from that devised, or at least adopted, by Briot, and figured in a rough marginal sketch appended to Sir James Hope's account of the "Fyning of Metalles," written in 1639.* It consisted of a vertical screw, worked by a lever, and terminating in a solid cylindrical cutter, which forced its way through the sheet or strip of metal, driving the blank before it, instead of allowing the latter to pass up into the interior of the hollow cutter as in Da Vinci's machine. It in no way differed from the cutter actually used in the Mint within the Tower of London, until its removal to the present site on Tower-hill. [One of these old cutters is now before you.]

The "blanks" may next be struck directly into coins, or they may first have their edges turned up by a special machine or be marked with letters, lines, or geometrical devices. The earliest coins that have such marked edges are those with serrated edges called by Tacitus, *nummi serrati*, represented, among the specimens shown, by a silver coin of the Roman Republic which somewhat resembles, as regards its edge, a coarsely cut watch wheel.

M. Castaing was probably the inventor of the machine for edge-marking. It consisted of two strips of steel bearing letters or an engraved device, which were placed horizontally and parallel to each other at a distance somewhat less than the diameter of the blank. One of the strips could be moved backwards and forwards by a rack and pinion, and when the blank was squeezed and rolled edgewise between the plates, the device was transferred to its edges. The instrument appears to have been in use in France in 1685.† The methods of imparting an impression to the edge of a coin, as part of the operation of striking in the coining press, will be noticed subsequently.

The operation of annealing the metal, either during the lamination or before the blanks are struck, is probably extremely ancient. "Blanching" also, or removing the alloying metal by the aid of dilute acid from the surface of the coins, has long been practised. The new money in the 18th year of Edward I. was "made white and refulgent by nealing and boiling," and the process remains in use until the present day.

* Hopetown papers.

† Boizard, "Traité des Monnoyes," p. 142.







Engraved by J. Myerhoff.

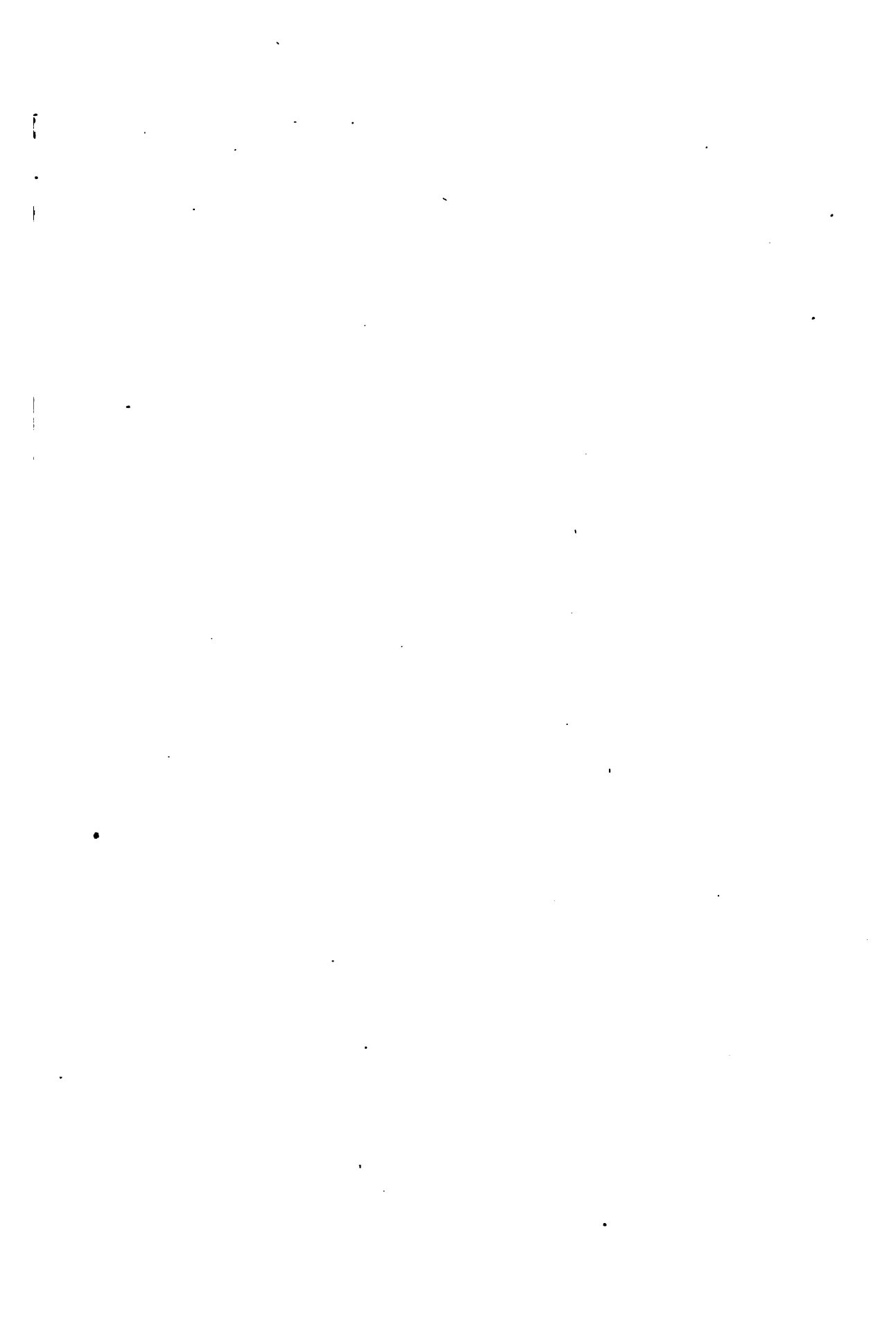
LEONARDO DA VINCI.

*After a Picture by himself engraved by
Guglielmo Deshayes*

Under the Superintendance of the Society for the Diffusion of Useful Knowledge

London, Printed by W. Clowes and Sons, 1825. Price 1s. 6d.

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ASTOR LENOX AND
TILDEN FOUNDATIONS
I







Engraved by H. H. H.

Engraved by George H. H.

London: Published by Henry Hoar & Charles H. H., 1844.

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ASTOR, LENOX AND
TILDEN FOUNDATIONS
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The next process to be considered is that by which the disc has an impression imparted to it, and is thus actually converted into coin. I have already referred to the use of the hammer, and will now only add that the prejudice or interest of the craftsmen called moneyers delayed its entire abandonment in this country until the year 1662, although, as we shall see, better methods were well known more than a century earlier than this date.

The hammer was succeeded by a block of stone or metal, which, guided between two rods, fell vertically on the upper die, between which and a fixed lower die the disc was placed. The great antiquity of this appliance is referred to in a letter from M. L'Abbé Barthélemy, to M. Rochon, by whom it is quoted.*

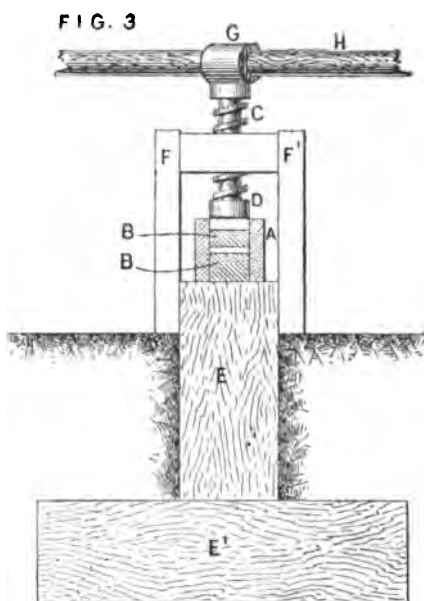
It is still extensively employed in the manufacture of buttons, and is used in the Royal Mint for making medal clasps. There is no evidence, as far as I am aware, that it was ever used in this country for striking coins, but it seems to have been employed for this purpose for a short period on the Continent.

The date of the invention of the screw-press is uncertain. It consisted of an iron frame, like an inverted U, in the bend of which a powerful screw fitted. The upper end of the screw was fixed to a cross arm furnished at its extremities, with heavy masses of metal; the lower end of the screw carried the upper die, the lower die being fixed in the bed of the machine.

Ruding,† quoting Le Blanc, says that the screw-press was introduced into this country in 1561, apparently by a Frenchman named Eloye Mestrell. It met with much opposition from the corporation of moneyers, and in 1572 Sir Richard Martyn, then Warden of the Mint, reported that, after repeated trials, it had been found defective. I am not aware that the exact form of Mestrell's press is known, but it cannot have differed much from the one in Italy at the same period, which is minutely described by Benvenuto Cellini,‡ who engraved coins for Pope Clement VII., and was perfectly familiar with this method of coining which he describes as *coniar a vite* in his treatise.§

A receptacle of iron (*staffa*, A, Fig. 3) is made of the size before mentioned (four fingers wide, two thick, and half a *bracchia* long), but so much longer as to admit, beside

the dies (*tasselli*, B B'), on which is the intaglio of the medal, the female screw of bronze, which is forced into it on the male screw of iron (*mastio*). This *mastio* is in fact what is actually called the screw, the female being called *chiocciola*, D. The screw should be three fingers thick, and the worms of it should be made square, as they have more strength than those made in the old way. The *staffa* must be open at the top, and, since the dies will be placed in it, and between the dies the metal that is to be stamped, it is necessary that the size of the *chiocciola* is such that it does not move in the *staffa*. As the dies



have to be somewhat smaller they are firmly fixed with wedges (*biette*) of iron, so that they do not move at all.

A beam of wood is prepared, E, two *bracchia* long, or more, which is buried so that only half a *bracchia* remains above ground, and that is planed smooth, the lower end is attached to a thick piece of timber, E', two *bracchia* long. In the upper end of the beam the *staffa* is placed in a notch into which it fits exactly.

Then certain wings (*aliette*, F F) are made of strong iron, which support the beam in which the screw is placed, so that it does not yield. The top of the screw is flattened (*stiacciata*), and in this flattened part is placed a great iron ring, G, having two ends which are open and fitted to a long pole (*corrente*, H) the length of which must not be less than six

* "Essai sur les Monnoies," p. 30. Paris 1792.

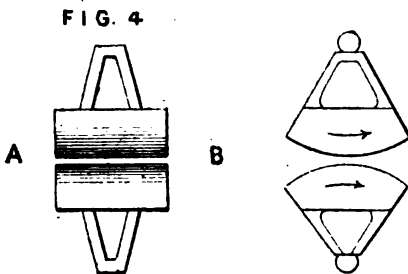
† Lansdowne MS. No. 5, cited by Ruding, vol. 1, p. 345.

‡ "Il Fiorino d'oro," p. 265. (Firenze, 1738.)

§ "Trattato dell' Oroficeria in Fiorenza, 1568," chap. x., p. 77. Ed. of 1731.

braccia, and then the stamps and metal being dexterously kept straight, the medal is brought to perfection by the aid of four men.

The next invention of importance seems to have been made by Nicholas Briot, to whom reference has already been made. He proposed to substitute for the screw-press a machine invented or probably only improved by him, which consisted of two semi-cylinders, each bearing an engraved device, the distance between them being so adjusted as to admit of an oval blank, the minor axis of which being inserted between the cylinders, received the impression when the cylinders were moved on their axes through part of a revolution. The disc was, at the same time, extended laterally by the pressure, so that the oval disc became circular. This explains the description given by Sir James Hope, of Briot's machinery, which was actually used in the Scotch Mint in 1639. He says, the blanks that "wer cutt ovall did receive their impression successivlie, by the quhilk they were forced to the bread (broad) and so wer maid round. . . . The forme of thair stamp is the portione or sectione of a cylinder engraven on both syds,"* and he fortunately gives a rough marginal sketch, reproduced in Fig. 4, which makes



A. Front view of the engraved cylinder. B. Probable end view

the general nature of the appliance evident. He specially says "that the stamp [or die] of those that wer cut round was flat, and impress thairupon by one force lyke to the cutting out press, which in principle exactly resembled a screw coining press."

There has been much misconception as to the nature of Briot's machinery, and Rochon expresses surprise† at the absence of any allusion to the screw-press, in M. Poullain's description of the procès verbal of the trial of machinery, made in Paris, in 1617; but as the machine invented and claimed by Briot,

* Hopetown papers, 19th January, 1639, quoted by Mr. R. W. Cochran-Patrick, "Records of the Coinage of Scotland," vol. i., p. lx. 1876.

† Rochon, "Essai sur les Monnoies," pp. 62 et 89. Paris: 1792.

coined by a squeeze and not by a blow, it is evident that it is quite distinct from the screw-press.

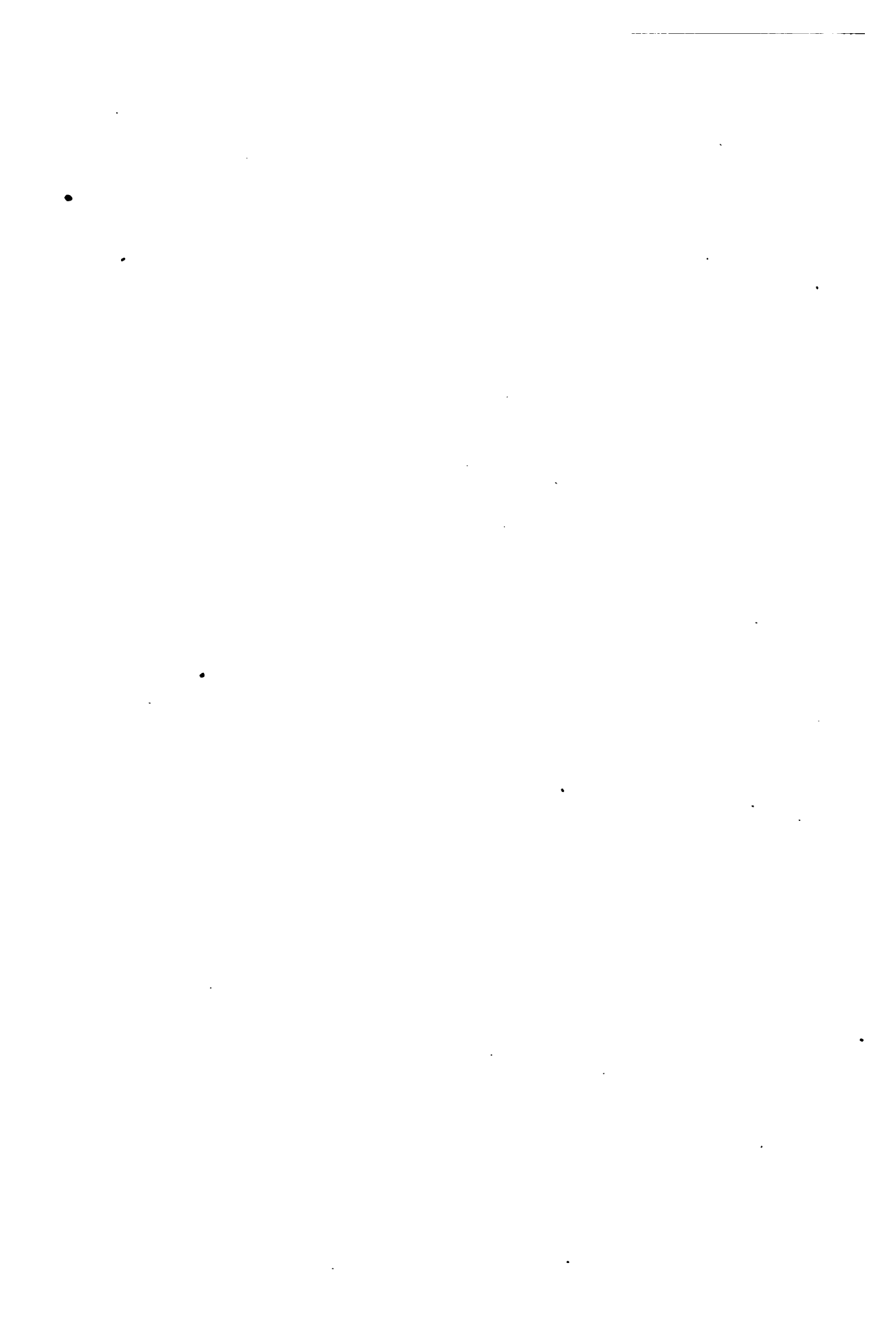
Dumas describes a similar machine in use at Geneva, in 1840, which consisted of two rolls, moving continuously, each roll being provided with four dies, capable of adjustment, so as to make each die on the upper roll correspond precisely with one on the lower roll. This arrangement enabled round blanks to be used instead of the oval blanks employed by Briot.

Briot's machinery does not appear to have had either a long or a widely extended use. It was soon abandoned in this country, and the method of striking by the hammer was resumed, and ultimately an improved form of screw-press was adopted.

I have dwelt on these appliances of Briot, because the lever-coining presses which have been definitively adopted in the newly organised Mint present some analogies to the above types; that is to say, they impart the impression by a squeeze, and against a definite resistance. Their analogy to Briot's machine will be made clear later on. But to return to the historical sequence. The hammer was still retained for coining in the Mint at the Tower of London, but the question of the adoption of the screw-press by the moneyers appears to have been revived in 1649, when the Council of State had it represented to them" that the coins of the Government might be more perfectly and beautifully done, and made equal to any coins in Europe." It was proposed to send to France for Peter Blondeau, who had invented and improved a machine and method for making all coins "with the most beautiful polish and equality on the edge, or with any proper inscription or graining." He came on the 3rd of September, and although a committee of the Mint reported in favour of his method of coining, the Company of Moneyers, who appear to have boasted of the success of their predecessors in opposing the introduction of the mill and screw-press in Queen Elizabeth's reign,* prevented the introduction of the machinery, and consequently he did not produce pattern pieces until 1653.

Early in the reign of Charles II. the consideration of the question was resumed, and Mr. Pepys states, in his diary under the year 1660-61, February 18th, that he "met with Mr. Slingsby, Master of the Mint, who showed me the stamps for the King's coyne, which is

* "Simon's Medals," by Virtue, p. 23, 1780.





strange to see how good they are on the stamp, and bad on the money for lack of skill "to make them." But, he says, Blondeau will shortly come over, and then we shall have it better, and the best in the world," and a year later, March 9th, 1662-3, he says, "Mr. Slingsby showed me examples of all the new pieces, both of gold and silver, that were made for the King by Blondeau's way."

It is certain that Blondeau did not invent, but only improved the method of coining by the screw-press, and I believe his improvements related chiefly to a method for "rounding the pieces before they are sized, and in marking the edges of the moneys with letters and grainings," which he undertook to reveal to the King. Special stress is laid on the engines wherewith the rims were marked, "which might be kept secret among few men."*

I cannot find that there is any record in the Paris Mint of Blondeau's employment there, and the only reference to his invention in the mint records of this country refers to the "collars" or perforated discs of metal surrounding the "blank" while it was struck into a coin.† There is, however, in the British Museum a MS., believed to be in Blondeau's hand, in which he claims his process "as a new invention, to make a handsomer coyne, than can be found in all the world besides, viz., that shall not only be stamped on both flat sides, but shall even be marked with letters on the thickness of the brim."‡ The letters were raised.

The press Blondeau used was, I believe, the ordinary screw-press, and I suppose that the presses drawn in Akerman's well-known plate of the coining-room of the Mint in the Tower, published in 1803,§ if not actually the same machines, were similar to those erected in 1661-2, by Sir William Parkhurst and Sir Anthony St. Leger, wardens of the Mint, at a cost of £1,400.||

Each press is served by four men, who set the cross-arm attached to the screw in motion by the aid of subsidiary jointed levers, which evidently allowed a certain amount of "play." Jars states¶ that the "balanciers" used in the Kremnitz Mint, one hundred years ago, required eight men at each press, when two

florin pieces were struck, and as the men worked for only a quarter of a hour at a time, they had to be replaced by another set of eight men, making in all sixteen men to each press.

The blanks seem to be placed between the dies by the hand of an attendant, but a system of mechanical "laying on," as it is called, had been suggested in 1727, by M. du Buisson;* and in 1807, Phillippe Gengembre† devised and introduced a simple and ingenious "layer on" which permitted blanks to be struck surrounded by a plain perforated disc of metal called the "collar," the removal of the finished coin and its replacement by a fresh blank, being performed automatically.

The screw-press of Boulton marks a great advance in mint machinery for the "cutting-out," and coining presses continued to be worked by manual labour until he claimed the "application of motive power to stamping and coining" in 1790, when a patent‡ was granted to him "for certain new methods of applying the powers of water mills, cattle mills, and steam-engines, either simply or combined with the pressure of the atmosphere" for the purpose of coining. He employed a screw-press in which the blow is imparted by the intervention of a vacuum chamber; that is, instead of workmen operating directly on cross arms, a lever at right angles to the screw is connected with a piston of a chamber rendered vacuous during the upward motion of the screw, which is effected, not by manual labour, but by a projection on a revolving wheel or, in later forms, by a lever. When the screw has been raised to the utmost limit of its path it is released, and the pressure of the atmosphere on the upper part of the vacuum chamber forces it down, and brings down the screw which bears the upper die.§

This press was finally abandoned in the re-organisation of the Mint machinery, effected in 1882, when the lever-press invented by Uhlhorn in 1829 was adopted. Some of these lever-presses had been in use in the Mint since 1872. A sketch of the portion of the lever machine (Fig. 5, p. 12) which bears the dies will be all that is necessary to make clear the principle by which it works. The blanks are placed at B, between the dies, D D, and the pressure is imparted by the toggle joint, E, and bent lever,

* Virtue's "Works of Simon," 2nd edit., 1780, p. 23.

† "Mint Records," vol. i, p. 144.

‡ *Numismatic Chronicle*, vol. i., 1838-9, p. 168.

§ "Microcosm of London," vol. ii., p. 202.

|| "Ruding," vol. ii., p. 7.

¶ Jars, "Voyages Metallurgiques," t. iii., p. 248, 1781.

* "Machines et Inventions approuvées par l'Académie," t. v., quoted by Rochon, p. 102, who fully describes the important details of the coining press.

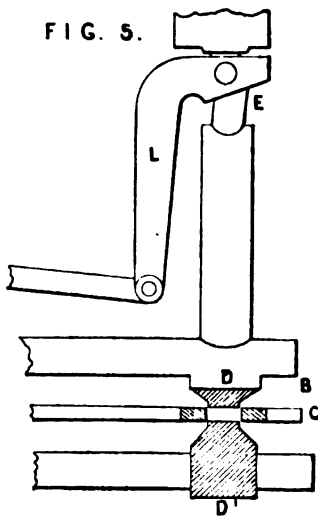
† Dumas loc. cit., p. 20.

‡ Patent, No 1,757, A.D. 1790.

§ This press is fully described in the eighth edition *Ency. Britt.*, vol. ii., p. 92.

L, and not by the partial revolution of a cylinder, as in Briot's machine. The edges of the coin may, at the same time, be marked with lines, or with a device, by means of a collar in the plate, c.

It is strange that the method of striking in a collar was not adopted earlier. The earliest reference I have been able to find, to a coin marked with letters on the edge, is a gold piece of Henry II. of France, dated 1555,* but the drawings of Leonardo da Vinci, published by Dr. Richter, clearly show that Da Vinci suggested the use not only of a collar fitting tightly round the blank, but of one capable of being divided into two portions, upon which a device might have been engraved, although he does not appear to have used such an engraved collar.



Simon's celebrated "petition crown," which bore an elaborate inscription on its edge, was probably not struck in a segmental collar, but in a plain one, the device being engraved on a steel spring, which was coiled inside the collar. A very slight pressure would remove the coin from the collar, and then the elasticity of the spring would remove it from the coin.

In conclusion, I would offer a few remarks with reference to the artistic side of the subject, in which the Society of Arts has always taken the deepest interest.

With regard to the substitution of the screw-press for the hammer in coining, M.

Lenormant observes, "mais l'art y a perdu comme il perd presque toujours à l'emploi des machines," and this is the complaint of a distinguished school in this country, whose view is probably based on the undoubted inferiority of modern work. But did art lose by the introduction of machinery? Such was not the opinion of Cellini, who advocated the use of the screw-press, nor of Da Vinci, who insisted that the discs should be cut with mathematical accuracy, and struck so as to ensure their being circular. It is not a little remarkable that the artists of the mints, the engravers, appear to have been the very people to urge the adoption of mechanical improvements. For instance, Nicholas Briot, "graver general of the monies," an excellent artist, quitted France in disgust because the introduction of his machinery was so bitterly opposed in that country. Jean Varin, Briot's successor in France, secured the definitive adoption of the screw-press in 1645, and Simon, Briot's pupil, and the greatest engraver England has ever had, aided Blondeau, who effected the great changes in the appliances of the Mint in the reign of Charles II., by secretly engraving the dies for him.

Speaking with no claims to artistic culture, I would venture to submit that no hand-struck Greek coins can be finer, as works of art, than certain machine-struck Renaissance coins, with designs in low relief, examples of which are now before you. The dies for striking them were either drawn or engraved by Francia, Da Vinci, Cellini, Hameranus, and Simon,* and the coins were struck from carefully rounded blanks. All these coins are surely marked by what Mr. Ruskin has called the "sign of the highest art," which "parts voluntarily with its greatness so to exalt and set forth its theme that you may be fain to see the theme instead of it."† In order to meet your obvious objection that these artistic questions are not in the province of the metallurgist, permit me to appeal to the words of Biringuccio, who, in 1540, in his advice to a Mint Master, reminded him that if he coined strictly according to the letter of the law, he would make but very small profits; if, on the other hand, he introduced too much base metal into the alloys, the

* The coins by Hameranus and Simon, to which special reference was made, were that of Pope Innocent XII., whose name is familiar to English readers from Mr. Browning's poem, "The Ring and the Book," and the "Petition Crown" of Charles II.

† Aratra pentelici, p. 121. 1872.

* Rochon *loc. cit.*, p. 101.

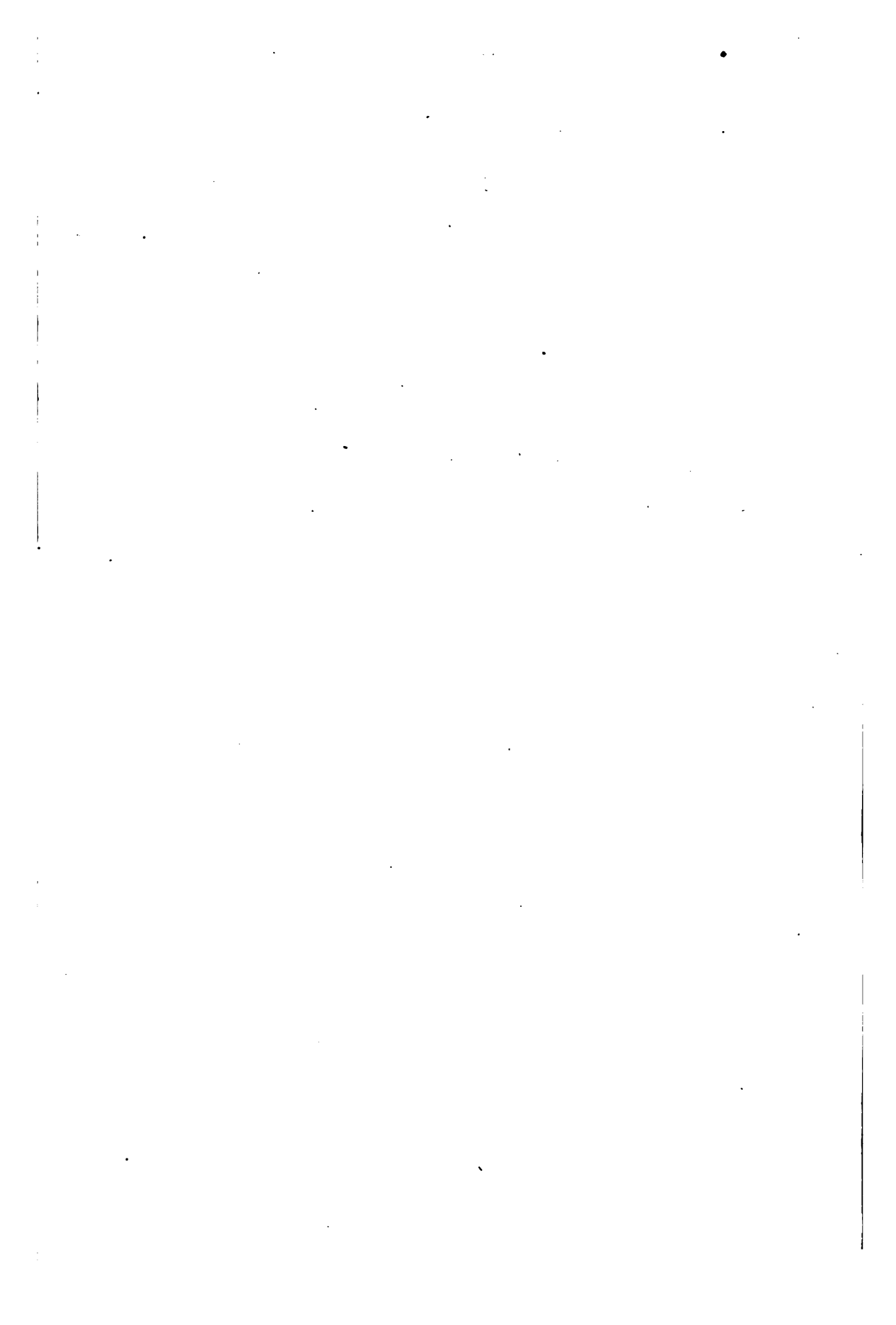


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execrations of the people would follow; but he specially urges that a good workman should be secured to engrave the dies, in order, as William Morris has said, that the people may have pleasure in things they must perforce use.

LECTURE II.—DELIVERED MONDAY, MARCH 24, 1884.

The meaning of the word alloy, in mint language, is different from that ordinarily accepted in scientific phraseology, as it is applied to the base metal added to a more precious one, and not to the mass, which may be either molten or solidified, of the mixed metals. This use of the word has been fostered by the way in which it has, from time to time, been employed in ordinances that have regulated the composition of the coin, and in the indentures made between the Sovereign and the Master of the Mint. It has also been perpetuated by the first schedule of the Coinage Act 1870, the legislative enactment which guides the currency at the present time. The earliest of these ordinances extant, that given by King Edward I. to Gregorie Rokesley, prescribes, that a pound of silver money shall contain "11 ounces, 2 easterlings (dwts.), and 1 farthing of silver, and the other 17 pence 3 farthings to be 'lay,'* that is, 'alloy.'" Biringuccio used the word with perfect accuracy in the 16th century. "I have told you," he says,† speaking of the gold alloys, "that an alloy only signifies an intimate association (*damicabile amicitia*) of one metal and another." The author of an interesting little work, entitled "A Touchstone for Gold and

Silver Wares,"* usually employs the word in the Mint sense, as when he says, "Silver having too little alloy would be too soft, so too much alloy would make it brittle like brass;" but Cramer,† a later writer, is scientifically accurate in calling a mixture of gold with silver a "white alloy." With regard to the derivation of the word, it may be sufficient to point out that the old French *alei* was retained in the Norman as *alai* or *allai*, whence our word alloy. Through the erroneous fancy that the French *aloi* was equivalent to *à loi* (to law) the word, meaning originally simple "combination union," came to be used specially of the mixing baser metal with gold and silver in coin, so as to bring it to the recognised standard, and hence of the standard itself.‡ The French word comes from *alleium* or *aladium*, the original being probably *ad-ligo* (alligo), to bind to. Used in the Mint sense, the relation of the word "lay" or "alloy" to the Teutonic *linderen*, to lessen, as pointed out by Sir John Pettus§ is suggestive, as it is in the sense of

* Second Edition, p. 8. 1679.

† "Elements of the Art of Assaying Metals," by J. A. Cramer, M.D. Second Edition, p. 118. London: 1764.

‡ A New English Dictionary, edited by J. A. H. Murray, Clarendon Press, 1884.

§ "Fleta Minor," Essay explaining Metallic words, see "Alloy" in the appendix. London: 1683.

* Ruding, vol. i., p. 192.

† Original Edition, p. 73. 1540e

a precious metal "lessened" in value, that "alloy" is retained in the Mint at the present day; but I may be permitted to repeat that this is an inaccurate use of the word, and that a sovereign should be viewed as a coined disc of an alloy of gold and copper, the union of the two metals constituting the alloy. The word sterling, again, deserves a brief notice, and I will only quote Stow,* as his explanation, adopted by later writers, is probably the correct one. He says, "but the money of England was called of the workers thereof, and so the Easterling pence took their name of the Easterlings, which did first make this money in England in the reign of Henry II., and thus I set it down according to my reading in Antiquitie of money matters, omitting the imaginations of late writers, of whom some have said Easterling money to take that name of a starre stamped on the border or ring of the penie: other some, of a bird called a stare or starling stamped on the circumference, and others (more unlikely) of being coined at Stiruelin or Starling, a towne in Scotland." Lowndes adopts this "Easterling" view of the origin of the word sterling,† and supports it by reference to a very old treatise "entered at large in the Red-book of the Exchequer, in the time of King Edward III," and he considers that the words "sterling" and "standard" are synonymous. Similar arguments are adduced at great length, with abundant references to authorities, in Hearne's "Curious Discourses."‡ The word sterling was, however, probably used to distinguish a definite alloy of silver and copper from certain other alloys containing less of the precious metal.

Throughout these lectures the words "standard fineness," indicates the amount of "fine" or pure metal present in any given alloy, and the degree of fineness will be expressed decimally, pure gold or pure silver being considered to be 1,000.

The reasons for the use of alloys, in preference to pure metals, are somewhat complex. In early states of civilisation coins are generally made of more or less pure metal, but a nation does not advance far in its history before the very important fact is recognised that alloys are more durable than pure metals, and that their substitution for pure gold or silver affords

a notable source of revenue. In cases where the coinage is in any degree international, the adoption of a low standard by one nation has to be followed by neighbouring nations, in order to prevent loss, and to facilitate commerce by avoiding the necessity for tedious calculations as to the rate at which coins may circulate in the respective countries. It is still possible, though not to the same extent, to make profits in the way indicated by Sir John Pettus, who, writing in the 17th century, observes, "it is good for a traveller to be skilful in different alloys, whereby, as a friend of mine told me, that he carried out £100 with him, and by his art of exchange in countries where alloys differed, he bore his charge of travel, and brought his stock home again."* A well-known modern instance of such a system is presented by the action of the first Europeans trading with Japan in virtue of the Treaty of 1858, who, availing themselves of the fact that the gold coins of that country were current at considerably less than their true value in silver, bought the gold kobangs then in circulation for about one-third of their actual value, and realised large profits.

The actual melting of the precious and base metal is effected in small furnaces with natural draught, and the crucibles employed are usually made of a mixture of graphite and fireclay. The capacity of the crucibles is very varied; those used in this country for melting gold hold about 1,200 ounces, and the crucibles for melting silver 4,000 ounces. Gaseous fuel is sometimes, though rarely, employed in mints, and I only know of one mint in which metal is melted on the open bed of a reverberatory furnace, and then of course the alloy to be formed is only bronze. The use of such furnaces would present some advantages, but as a considerable amount of metal would be, temporarily at least, hidden in the more or less leaky furnace bed, it becomes absolutely necessary to employ crucibles for melting the precious metals.

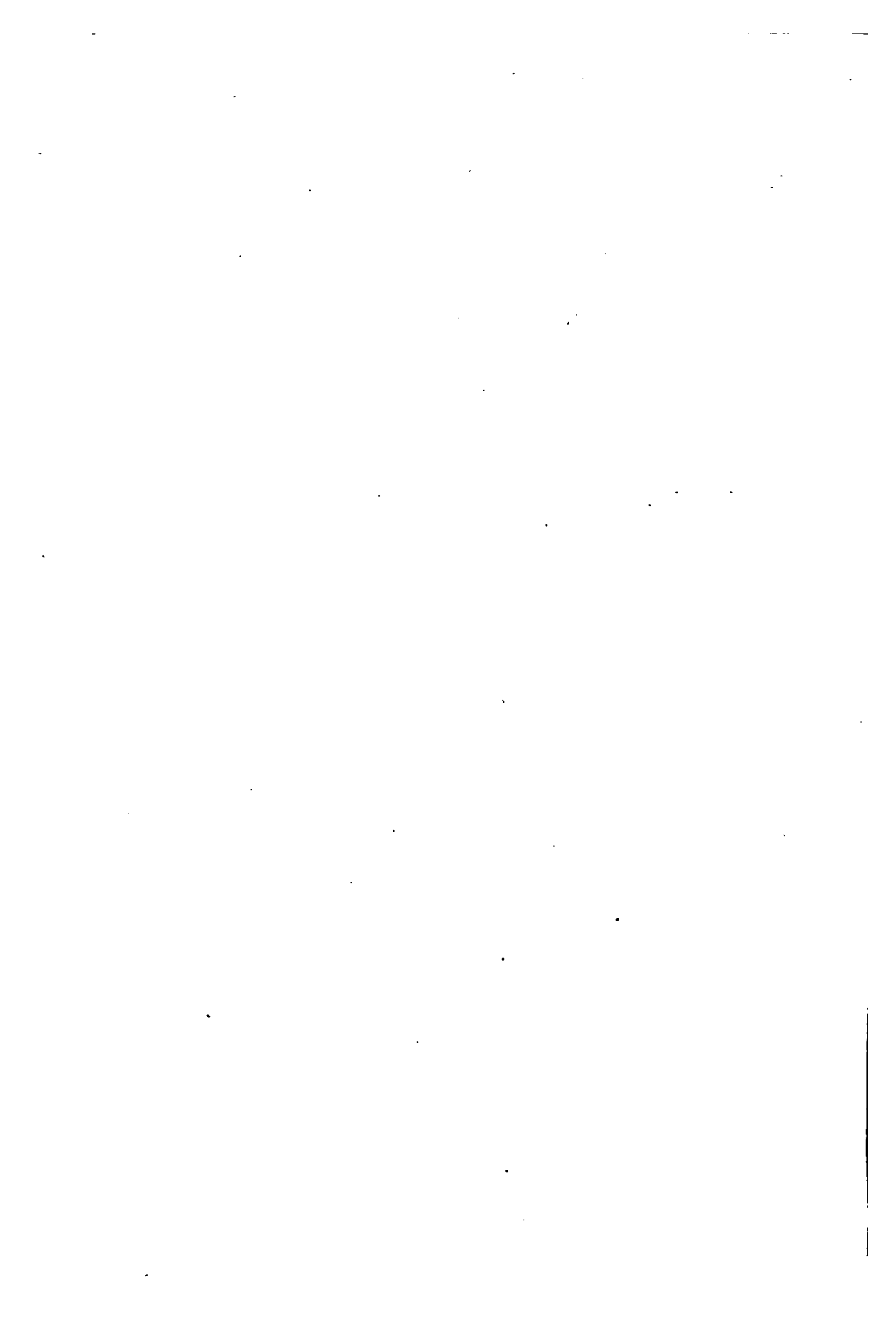
With regard to the choice of the base metal to be added to the precious, many conditions have to be taken into consideration. The resulting alloy must be of good colour, must be ductile, and must not exhibit any traces of brittleness. In the case of gold, silver forms a very ductile alloy, but then, as we have seen, it sensibly lowers the colour of the gold. Copper, on the other hand, heightens the tint, and has the advantage of yielding a durable

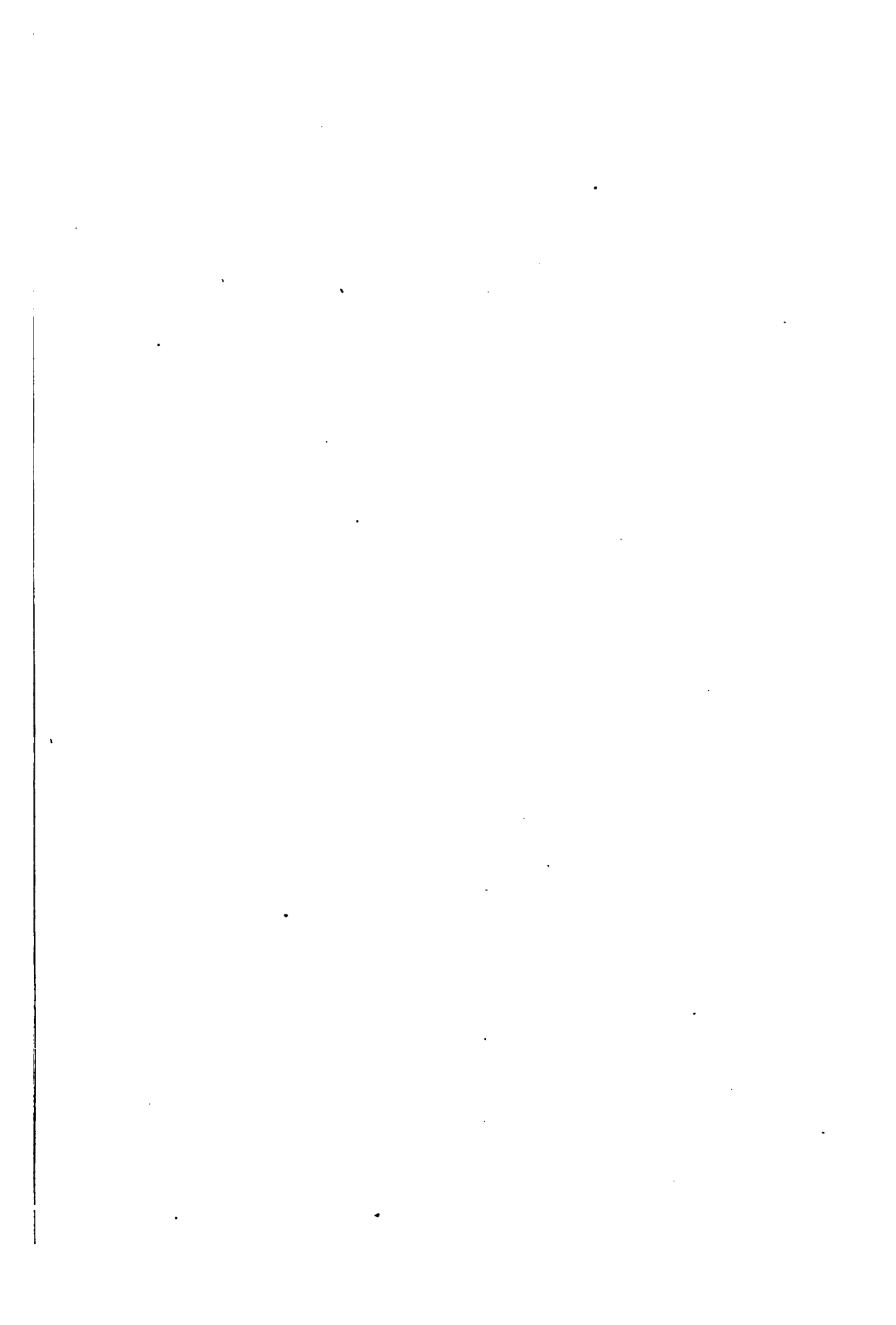
* "A Survey of London," by John Stow, p. 52, 1603.

† "Essay on the Amendment of the Silver Coins," p. 16, London, 1695.

‡ Edition of 1771, vol. i, p. 10 and 13, and vol. ii, pp. 375 and 379.

* Fleta Minor, Appendix, word, "Money."





as well as ductile alloy. A triple alloy of gold, silver, and copper may be made of delicate tints, but a triple alloy is difficult to assay, and it is undesirable to complicate the accounts of a mint by the use of two precious metals and a base one in the same alloy, therefore a single base metal, copper, is now almost universally used.

It has long been known that the union of two or more metals produces a result which often differs more in physical properties from either of its constituents than they do from each other. Copper and tin, for instance, alloyed in definite proportions, yield alloys of a wide range of properties, and there is hardly any fact more remarkable in the whole range of metallurgy than the enormous influence exerted on a large mass of metal by a small quantity of another metal or metalloïd.

From the Mint point of view, the properties which it is most desirable to secure are—1. Ductility; 2. Durability; 3. Uniformity of composition.

In addition to these, the alloy is expected to be sonorous, that is, the coin struck from it must have the true "ring;" and, finally, it must possess exactly the degree of viscosity which will enable it to flow, under pressure, into all the fine lines of an engraved die, while at the same time the metal must have sufficient rigidity to retain its impression when submitted to rough usage. This question of the flow of metals has been beautifully worked out by M. Tresca,* who has shown that when metals and alloys are submitted to compression, they so closely resemble fluids in their behaviour, that the shape they will assume can be deduced by calculation. In coining a disc of metal, the engraved work of the die forms a series of channels designed to facilitate the flow of the metal of which the coin or medal consists, and to guide it in the required directions. In the compression of a "blank" between dies, the portions not to be brought into relief by the action of the press are reduced in thickness for the benefit of the neighbouring raised portions, the metal literally flowing from the level parts to the reliefs.

I once heard Mr. Ruskin say in a lecture:—"You stamp the effigy of a cow on a pat of butter, why don't you stamp the bee on the honey?" Simply because one is much more viscous than the other, and will not retain a shape given to it; and from the coining point of view this is precisely true of lead, which

rapidly becomes defaced by only a moderate amount of wear, and in a less degree of pure gold. It is absolutely necessary to add some other metal which will form a more or less rigid alloy.

With regard to the sonorous property of the alloys used for coining, if two rods, one of pure silver, and the other of the alloy of silver and copper, known as standard silver, be hung close together, one will ring loudly when struck, while the other gives a comparatively indistinct sound. The best indication, however, of the total difference between the molecular grouping of a pure metal and an alloy, is afforded by their electrical behaviour.

It will, I trust, be evident that the base metal added to gold or silver may be regarded from two distinct points of view; either as a useful constituent of the coin, which enables it to resist wear and hinders the obliteration of its impression, or, if coins containing base metal are made current at more than their intrinsic value, as a source of gain to the rulers of a country. With regard to the actual standards of fineness which have, from time to time, been employed, it may be pointed out that, in the numismatic history of the world, endless combinations of precious and base metal have been represented. Pure gold and silver have been used, either singly, or alloyed with each other, or alloyed with copper, the latter metal, in turn, being sometimes employed with only infinitesimal additions of precious metal.

The alloys actually used for coinage at the present time are not numerous, and it may be well to begin the consideration of such as are specially important by tracing the steps which led to their adoption.

In the case of both the gold and silver currency of this country, the adjustment of the relative proportions of the precious and the base metals was undoubtedly guided by the particular systems of weights used. To take the silver coinage first, the fineness of alloys of this metal has from very early times been computed by divisions of the troy pound, which weight is still retained in weighing gold and silver. The Commissioners appointed in 1868 to inquire into the conditions of the Exchequer standards, state that "the troy pound is said to have been derived from the Roman weight of 5759·2 grains, the 125th part of the large Alexandrian talent, this weight, like the troy pound, having been divided by the Romans into twelve ounces;" and they add, "the troy weight is universally

* Paper read before the Society of Mechanical Engineers of Paris; translated, *Journal of Franklin Inst.*, Philadelphia, 1878, vol. lxxvi., pp. 263-266.

allowed to have been in general use from the time of King Edward I. The most ancient system of weights in this kingdom was that of the moneyer's pound, or the money pound of the Anglo-Saxons, which continued in use for some centuries after the Conquest, being then known as the Tower pound, or sometimes the goldsmith's pound. It contained twelve ounces of 450 grains each, or 5,400 grains, and this weight of silver was a pound sterling. The Tower pound was abolished in 1527 by a statute of King Henry VIII, which first established troy weight as the only legal weight for gold and silver. . . . From that time to the present our system of coinage has been based on the troy weight."* The computation of the standard fineness of alloys of gold is based on the singular "carat" system of weights, the origin of which is popularly believed to have been derived from the weight of an oriental plant-seed. Mr. H. J. Chaney, who is entrusted with the duties of the office of Warden of Standards, informs me that "its history is not easily traced, but that the origin of the carat is doubtless Grecian. The *ceratium* was a small Greek weight."† It is uncertain whether the use of the carat came to us through the Arabian alchemists, or through the Roman mints, and the exhaustive inquiries of Vasquez Queipo do not throw much light upon the point; but with regard to the supposed derivation of the weight from the seed or bean, Mr. Chaney thinks "it is more probable that the Greek *Keration*, and the Arab *Kyrat* were applied to the beans or seeds by the native merchants, who made them serve provisionally as weights.

It has been necessary to offer the foregoing explanations, because the expression of the varying standards of fineness, either in the "carat and grain" system or in the "ounces, pennyweights, and grains" of the troy system, is somewhat obscure to those who are not familiar with their use; and although the decimal system will be adopted for the purposes of this lecture, it will be difficult to avoid references to the older methods of computation.

In 1790, Mirabeau, in an elaborate memoir submitted to the National Assembly in France,‡ urged that the decimal system should be applied to the coinage, and, as will be shown subsequently, his views were adopted in 1794.

* Third Report of Commissioners. Parliamentary Paper, c. 30, p. iii., 1870.

† Quoted by Mr. Chaney, in a letter to me, from "Lucae Paeti de Mensuris et Ponderibus," Venetiis, 1573, p. 88.

‡ "Collection complete des Travaux de M. Mirabeau l'ainé à l'Assemblée Nationale," Paris, 1792.

The use of this system spread rapidly over the Continent, but the computation of the fineness of gold alloys by the system of carats and grains survived in the English Mint until 1882, when the decimal system was introduced.*

With these remarks we may proceed to the consideration of the alloys used for coinage in early times.

It may be convenient to begin the history of the alloys used for coinage with the employment of the natural alloy of gold and silver, to which the ancients gave the name of electrum, native gold being always associated with silver, which is sometimes present in sufficient quantity to sensibly lower the colour of the more precious metal, and to cause the gold tint to disappear almost entirely when it exceeds one-third part of the mass.

Dr. Schliemann describes† three pale yellow rod-like bars, each 4.33 inches long, provided with fifty to sixty equi-distant horizontal incisions, at right angles to the length of the rods, which probably indicated their value, and facilitated their sub-division into definite portions. Dr. Schliemann kindly permitted me to analyse a small portion of one of these rods, which was found to contain 651 parts of gold, and 334 parts of silver in 1000 parts, and small quantities of copper and lead.

In a dissertation on the Homeric talent, Dr. F. Hultsch states that it weighed 16.8 grammes, or a little above $\frac{1}{2}$ oz. troy, and was the prototype of the oldest gold stater, coined in the beginning of the 7th century B.C., at Phocæa, and other cities of Asia Minor.‡ I have already referred to the coined nuggets of electrum which may have been adopted for purposes of currency long before the use of coined money; but, as M. Lenormant points out,§ in the series of coins of the kings of Lydia, gold and electrum were coined simultaneously, as distinct metals, having distinct monetary values.

The numerous analyses made by Dr. Rauch|| and others have placed at our disposal much accurate information as to the standard fineness of the alloys used for coinage in Greek and Roman times. M. Lenormant,¶ who devotes a considerable portion of his elaborate work to the consideration of this subject, observes "that in the Hellenic world the coins of gold

* 13th Annual Report of the Deputy Master of the Mint, 1882, p. 46.

† "Ilios," p. 496. London, 1880.

‡ "Griechische und Römische Metrologie." Berlin, 1882. Quoted by Dr. Schliemann, "Troja," p. 213. London, 1884.

§ "La Monnaie dans l'Antiquité." Paris, 1878, t. i., p. 194.

|| Zeitschrift für Numismatik. Band 1, p. 36, 1873.

¶ Op. cit. t. 1, p. 187, et seq.





and silver were remarkably pure, the gold coins sometimes contained only three parts of silver in the 1,000, which represented the highest degree of purity attainable by the method of refining then in use.* In the coins of Darius a little base metal was intentionally introduced, but its amount did not exceed 30 parts in the 1,000, and, speaking generally, the Grecian silver coins contained considerably less base metal than coins issued in modern times. The standard of the tetradrachms of Athens, at the best period, varied from 983 to 986, while those of the second series fell only as low as 966, and these contained 2 parts of gold in the 1,000, as well as the 32 parts of copper. A series of Greek coins struck in Italy and Sicily in the 6th century before the Christian era, vary in fineness from 910 to 980. At the end of the coinage at Tarentium, the standard was sensibly lowered, for a didrachma assayed by Dr. Rauch was found to have only the fineness 880, but M. Lenormant observes that, in the entire series of Asiatic coins before the conquests of Alexander, there is no essential change in the standard of silver, which is uniformly high, although instances are met with of coins of as low a standard as 709. With regard to Roman money, I will only quote Lenormant's statement that the gold of the Republic was always pure, and that Imperial gold coins, until the time of Vespasian, were of excellent quality, although their standard was slightly reduced, that is, from pure gold to standard 991. After the time of this emperor, the standard appears to have fallen to 938, and subsequently, about the time of Septimus Severus, it fell much lower. In the year 265 A.D. the gold coins were struck in a base alloy, containing—

827·3 of copper.
159·4 „ silver.
13·3 „ gold.

1000·0

The silver of the Republic was always excellent, varying, according to Darcet, from 993 to 995, but under Imperial rule its debasement appears to have been rapidly effected, especially from the time of Nero until the 3rd century, when the silver became mere *billon*, containing—

820 of copper.
160 „ lead and tin.
20 „ silver.

1000

* This was the cementation process described by Geber in the 8th century, of which a full account is given by Biringuccio, original edition, p. 72 (1540).

From the time of Diocletian, when the coinage of silver was resumed, it was of excellent quality. A series of Roman coins of the first three centuries, found at Baden Baden in 1828, was analysed by Dr. Walchner of Carlsruhe, whose results may be briefly stated as follows. A coin of Heliogabalus proved to be the lowest standard (505), while one of Antoninus Pius, which contained 913 parts of silver, was the highest, coins of Commodus, Domitian, Hadrian, and Trajan varying from standard 797 to 890.* It may be added that there was a coin of the Triumvir Antoninus† (B.C. 31) which had almost the same composition as British silver coin, as it contained—

925 of silver.
71 „ copper.
2 „ lead.
1 „ gold.

999

Time will not permit me to trace the varying changes in the fineness of coins issued in the barbaric times which followed the overthrow of the Roman Empire. Judging from their appearance, the coins present endless variations of standard. In view, however, of the special interest connected with the early British series, I may point out that Mr. John Evans‡ has clearly traced the design they bear to the stater of Philip of Macedon, who struck the coin in question of gold of a high degree of purity. In view of this lecture, I have assayed an early British gold coin, believed to have been struck at a period ranging from 50 to 60 B.C.§ Its design well exhibits the characteristic evidences of its descent, and it proved to contain—

403·5 of gold.
400·2 „ silver.
196·3 „ copper (by difference).

1000·0

The next historical point is presented by the early Saxon sceattæ, a single specimen of which, assayed by me, proved to contain 558 of silver, 12 of gold.

I have also assayed a silver coin of Burgred King of Mercia, 852-874, A.D., which proved to be of so low a standard as 331·6; and one of Ethelred (978-1016 A.D.), which contained 918·1 of silver, and a little gold, while a coin

* Quoted by Dr. Percy, "Metallurgy of Silver and Gold," part i, p. 169, 1880.

† "Die Metallurgie. Metallverarbeitung," Prof. A. Ledebur, p. 86, 1882.

‡ "The Coins of the Ancient Britons," p. 23. London, 1864.

§ This coin is similar in design to that figured Plate C, No. 8 of the above work.

of Canute (1016 to 1035 A.D.) was of standard 931. Two coins of King Edward the Confessor, one of them kindly given me by Mr. John Evans, for the purpose of assay, proved to be of standard 943·2, and 940·4, both coins containing, in addition to the silver, nearly 2 parts of gold in 1000.

With these slender links, I must pass to the series of coins which began with the Norman conquest, observing, however, that a further connection between the Roman, mediæval, and modern series is maintained by at least two coins, which were so widely circulated, that they may almost claim to have afforded an international currency. These coins are the "bezant" of Constantinople, and the "florin" of Florence, which we know to have been of nearly pure gold.

"The gold bezants of the Greek Empire, and the gold coins struck during the 9th and 10th centuries by Arabic princes, in Sicily, were probably used, more or less, in mercantile transactions all over Europe, and are found occasionally in this country, but they had no legal currency here, and were probably accepted merely as bullion. In the middle of the 13th century, however, a native gold coinage was almost simultaneously adopted by the European nations. The first gold florin was issued by the Republic of Florence, in 1252. Louis IX. introduced gold coins into France, and the Emperor Frederick II. into his kingdom of Naples, and at about the same time the same innovation took place in England."*

In the accompanying diagram (p. 19), the dates of issue, and the standards of fineness of the gold and silver coins of this country have been taken as co-ordinates, the points being mainly plotted from the tables given by Ruding.† Taking the gold coinages first, it will be seen that the line begins at the year 1257, the 41st year of King Henry III., who made a penny of the finest gold, which weighed two sterlings. This, as Ruding points out, is remarkable as the first coinage of gold in the kingdom, and it is extraordinary that it took place at the height of the king's distress for want of money. The next step of importance was taken in 1343, when King Edward III. coined, or projected a coinage of the standard 994·8 [23 carats, 3½ grains, and ½ grain of alloy], which was referred to by later writers as the "old sterling" or "right standard" of

England; and Lowndes, quoting the Red-book of the Exchequer, says, that the ¼ grain of alloy might be either of silver or copper.* Although these were not, as Stow considered, "the first coining of gold in England," the coins of Edward III. were of remarkable beauty, and it was asserted that they were struck from gold prepared by occult aid, by the well-known alchemist, Raymond Lully, who had a laboratory in the Tower of London. There are, however, chronological difficulties in the way of this explanation of the origin of the precious metal. As the diagram shows, no further change was made in the standard fineness of the gold coin until the year 1526, when King Henry VIII. introduced a second standard 916·66 [22 carats], the professed object being to prevent the exportation of the coin to Flanders. The further modification of the standard, which was effected in 1543, was preceded by a kind of scientific research, as the King ordered the Officers of the Mint to prepare, whenever they should be so directed by the Privy Council, alloys to the value of one pound in weight, of such fineness as should be devised by the said Council, in order that the general nature of alloys, similar to those used in foreign realms, might the sooner come to his Majesty's knowledge. The standard 916·66 [or 22 carats fine] (which is the standard of the alloy used at the present day for the gold coinage of this country) was again issued in 1544. By a subsequent indenture, dated 1545, the gold was brought down to 833·3 [20 carats fine].

King Edward VI. improved the fineness of the gold currency in 1549, and in 1552 an indenture was made authorising the coinage of gold both of the old standard 994·8, and of the standard 916·6. Queen Mary issued coins of fineness 994·8 [23 carats 3½ grs.]. Queen Elizabeth struck coins of both standards. As the diagram shows, the coinage of gold of the "old standard" 994·8 was abandoned in the 12th year of King Charles I., and since that time the standard 916·6 [22 carats fine], has alone been issued. Coins made of the old standard previously to that period continued to be current until the year 1732, when they were withdrawn from circulation by proclamation.†

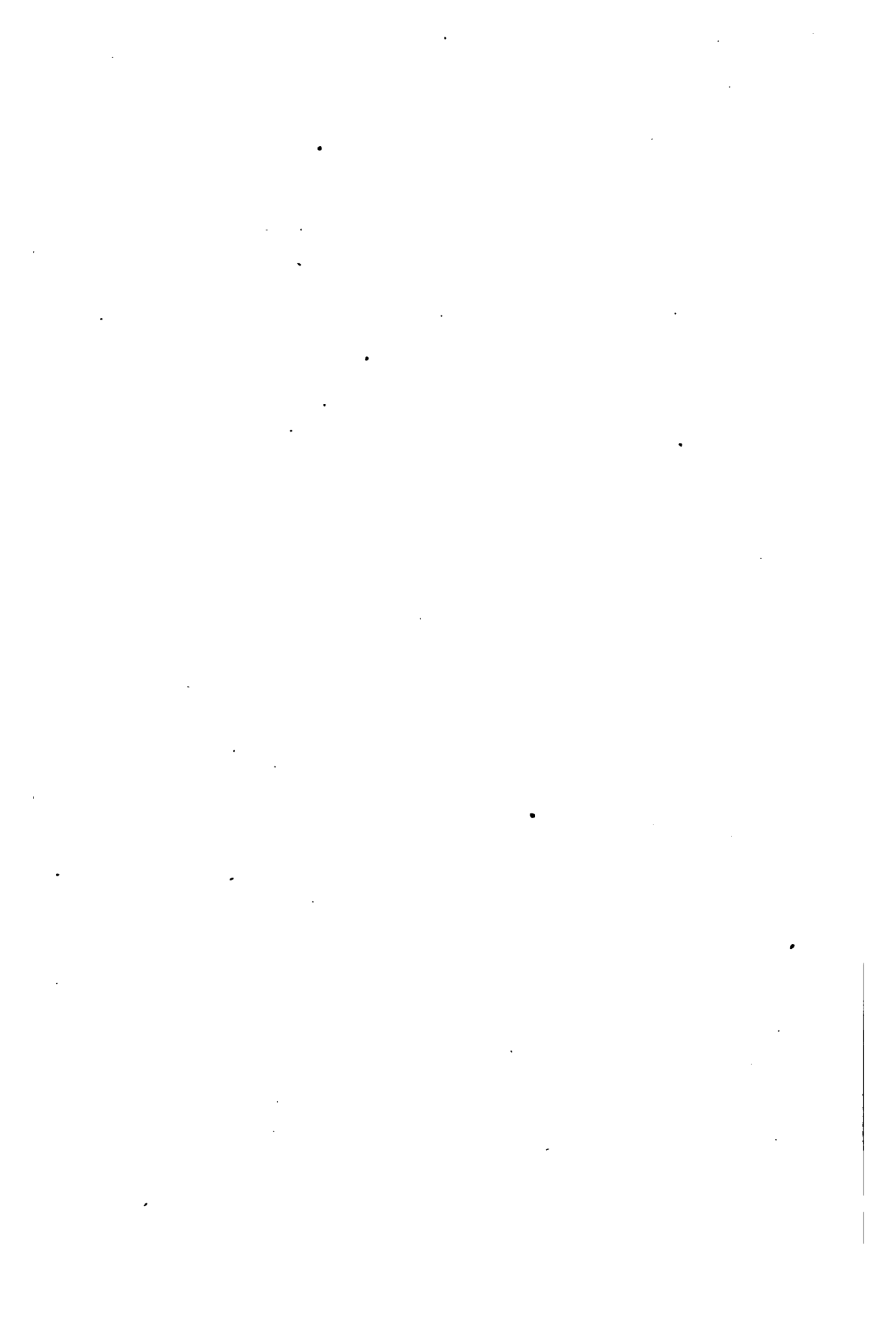
The vicissitudes through which the silver coinage has passed have been greater than

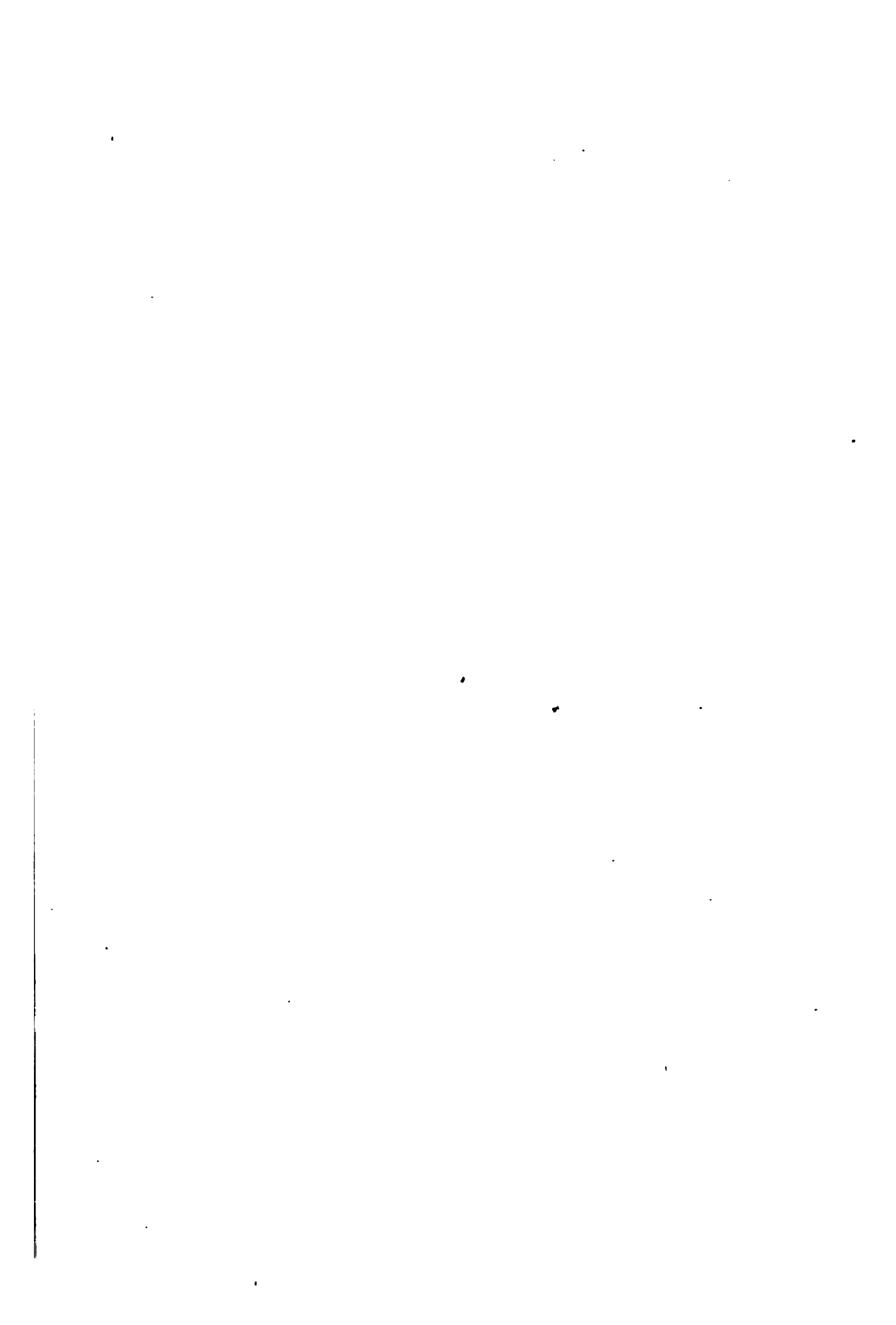
* "The Gold Coins of England," by R. L. Kenyon, p. 14, 1884.

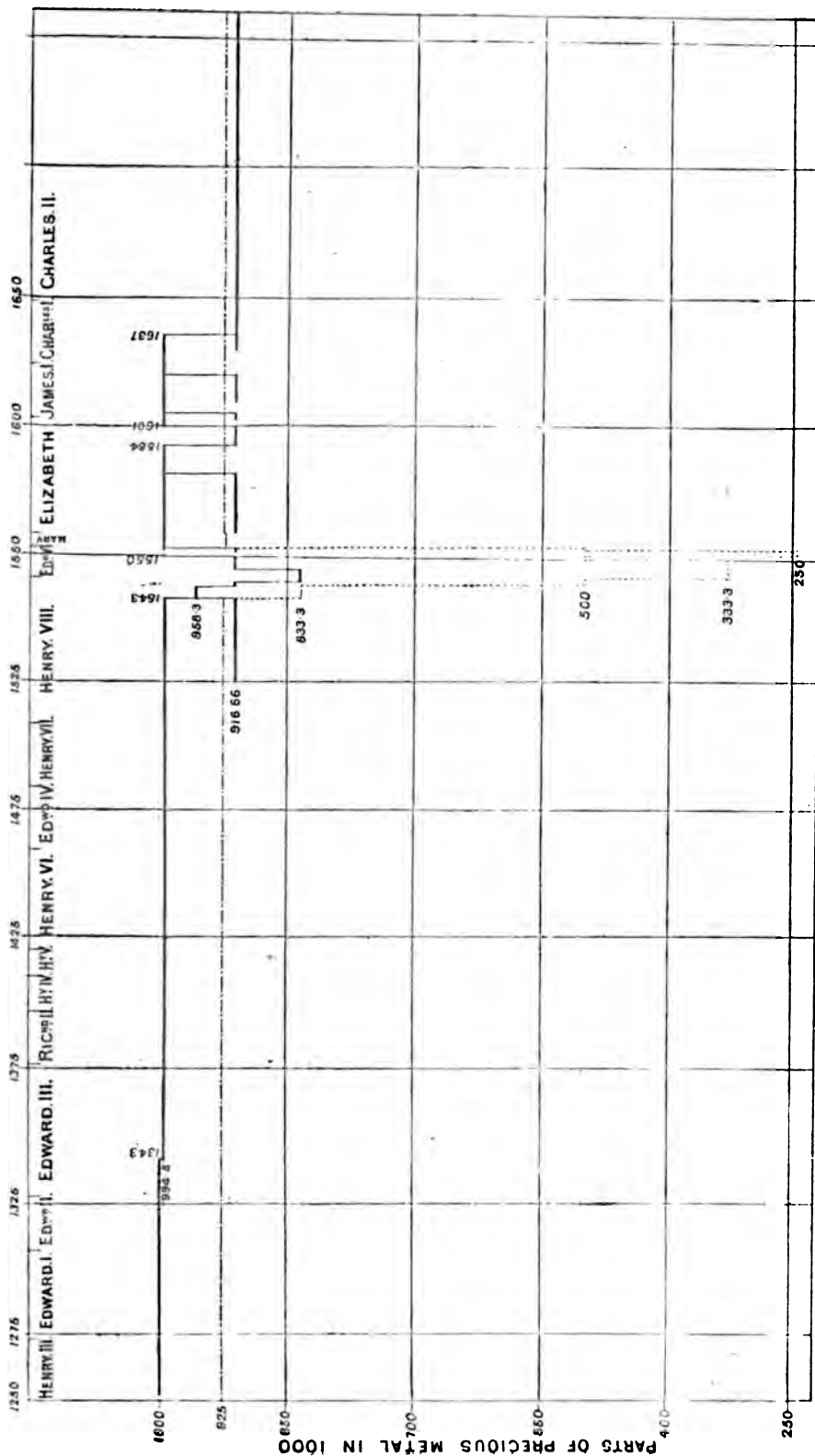
† "Annals of the Coinage," vol. i., p. 10.

* "Lowndes, Essay for the Amendment of the Silver Coin," p. 18. London: 1695.

† Lord Liverpool's letter to the King, p. 32. Edition published by the Bank of England, 1886.







The gold coinages are represented by a thick line, thus :— The silver by a dotted one — Changes of standard are indicated by a thin vertical continuous line in the case of gold, and by a thin dotted line in the case of silver. The scale is doubled at the critical period between the years 1525-50. There has been no change in the standard of gold since the year 1660, or in the standard of silver since the reign of Queen Elizabeth.

those that have affected gold. I have selected a few examples of coins issued before the Norman Conquest, and have assayed them. A coin of Burgred contained only 302 parts of silver in the thousand, while one of Ethelred was 918·4, and was probably intended to represent the old standard of England, 925. A coin of Canute proved to be of standard 931, which was clearly intended to represent the old standard. Two separate coins of King Edward the Confessor, assayed by me, proved to be 941, which is "better" than standard; but Mr. John Evans, who kindly gave me one of the coins, considers that this slight superiority to standard is due to the fact of copper having been removed from the surfaces of the coins by the operation of cleaning to which they had been submitted. Anglo-Saxon and Anglo-Norman coins are believed to have been of the "old standard," 925, and a coin of William the Conqueror which I assayed, proved to be 922·8. In England, this old standard appears to have remained unchanged until the 34th year of King Henry VIII., when, as the diagram shows, a great fall took place. It will be seen that a still deeper fall in the standard fineness ensued in 1545, and again in 1546, and in the reign of Edward VI. It fell to its lowest point in the fourth year of the latter monarch, when the pound of silver contained only three ounces of fine silver, and nine ounces of base metal, that is, the standard, expressed decimally, was only 250. Strangely enough, this base coinage was projected with a view to secure by the transaction the sum of £160,000, to be devoted to the restoration of the standard generally. Half this sum appears to have been actually obtained. As a step to the withdrawal of the base money, it was almost universally decried, that is, the coin which had been current at rates far above its intrinsic value, was officially reduced to a value nearly corresponding with its standard of fineness. Dreadful distress was caused to the people, and the saddest pictures are drawn of the financial condition of England at the time. In 1552, the standard was restored to nearly its original richness, as coins containing 11 oz., 1 dwt. of pure metal, and 19 dwts. of base metal, or standard 921, were issued, and this alloy was maintained by Queen Mary. The diagram shows that Queen Elizabeth further contributed to the restoration and maintenance of the standard fineness of the coin. A proclamation, dated September 27, 1560, stated that "her Majesty, who, since she came to the throne, never gained anything by the coinage,

nor yet ever coined any manner of base monies, for this realm, had begun a coinage of fine money in the Tower of London." Notwithstanding the Queen's efforts to restore the coinage in England, the coins circulated in Ireland were deplorably low, as the pound only contained 2 ozs., 18 dwts. of fine silver, and 9 ozs., 2 dwts. of copper (that is the standard was only 241). Well might that shrewd economist, William Stafford,* remind her Majesty that, "though gold and silver be the mettals comonly wherin the coyne is strycken to be the tokens for exchange of things between man and man, yet it is the wares necessary for man's use, that are exchanged in deede under the outward name of the coyne;" or, in other words, by diminishing the value of coin, its purchasing power is diminished.

The restoration of the standard of the silver, begun in the reign of King Edward VI., was, however, completed by Queen Elizabeth, and it has not been since debased.

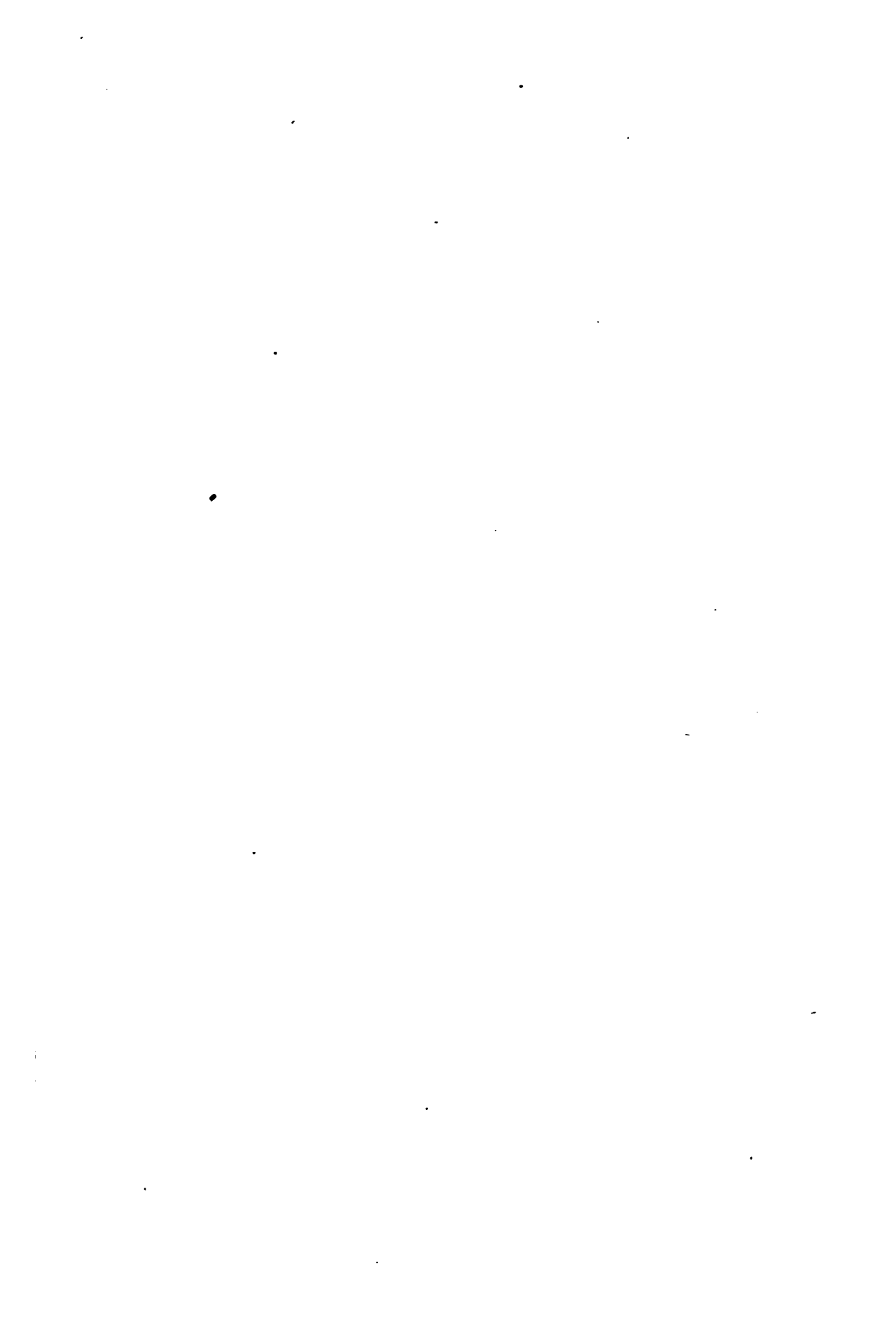
Before leaving this part of the subject, it may be well to offer a few remarks on the debasement of coinage generally. The famous antiquary, Sir Robert Cotton, in a well-known speech made before the Privy Council in the reign of Charles II., observes, "what renown is left to Edward I. in amending the standard, both in purity and weight, . . . must stick as a blemish upon princes that do the contrary. When Henry VIII. had gained us much of power and glory abroad, and of love and obedience at home, as ever any, he suffered shipwrack of all upon this rock." And he elsewhere points out "that every man will rate his commodity in sale, not according to the account of pence or pounds, but to the weight of pure silver contained in the current money."

With reference to the apparent motives for the debasement of the currency, Lord Liverpool observes that "these motives were, first, a desire of augmenting the royal revenue, and, second, principles of mistaken policy," supported by "an idea that they should thereby prevent the coin from being exported," and he adds, "but this idea has been fully exploded since the principles of commerce and foreign exchanges have been well understood." † It may be pointed out that the exact standard fineness of the alloy used is a matter of but small importance, and that a coin poor in precious metal is not really "debased," if it

* "A Brief Concept of English Policies," p. 29. London, 1587.

† Op. cit., p. 223.





is not made current at a rate below its intrinsic value.

One other method of debasing the coinage remains to be noticed, which was, so far as I know, confined to Roman times. It consists in the issue of pieces of copper, iron, lead, or tin, plated with a thin layer of silver, or more rarely gold. The workmanship of such coins exhibited much skill and care, and they appear to have been issued simultaneously with coins of full value, often with a view to defray the cost of the coinage of the good pieces. An elaborate literature has been devoted to them, which has been well condensed by M. Lenormant.*

The issue of coins of base metal by King James II., for use in Ireland, can hardly be called a depreciation of the standard, as in many cases they contained no silver at all, but were made from old guns, bells, kitchen utensils, "and the refuse of metals molten down together, and valued, by the workmen in the Mint, at no more than three or four pence the pound weight; but when coined into six-penny, shilling, or half-crown pieces, and made current by arbitrary power, it passed at the rate of five pounds sterling the pound weight, or eleven thousand two hundred pounds the ton, when at the real value, namely, fourpence the pound weight, the compound metal was not worth more than thirty-seven pounds, six and eightpence the ton."†

I have thus attempted to trace the history of the gold alloy of standard fineness 916·6, and the silver one of 925, the alloys used in this country for the gold and silver currency, and as the gold represents a large proportion of the coinage of the world, it may fairly claim to be the most important gold alloy in existence. England is not the only country in which it is retained; the explanation of its existence in other countries is found in the fact that standard 916·6 is the metric equivalent of 22 carat gold, and, as the carat system has been in use from early times, it is natural that many nations should have originally adopted the convenient proportion presented by $\frac{22}{24}$, or $\frac{11}{12}$, which this alloy represents, and it has, accordingly, held its own in British India, Russia, the Turkish Empire, Portugal, Persia, and with a slight variation in Brazil.

As it will not be possible to examine the history of the alloys at length, attention must

be limited to the more important ones, of which the alloy containing 900 parts of gold in the 1,000 parts demands special notice.

The coins in circulation in France from the beginning of the 17th to the end of the 18th century varied in fineness from 900 to 982; for instance, the louis d'or of King Louis XIII. were 22 carats fine, the ecus d'or of Louis XIV. were 23 carats, while the lys d'or of the same monarch were 23 carats and one-fourth of a grain.*

When, however, the decimal system of weights and measures was fairly established, coins were issued in conformity with it. The law of the 28th Thermidor, An. III. (1796), fixed the franc as the monetary unit, and enacted that the standard fineness of the silver coins should be 900, the weights as well as the fineness of the coins being strictly in accordance with the decimal system, although round numbers were not secured in the respective weights of the coin. Eight years later, the law of the 7th Germinal, An. XI. (28th March, 1803), prescribed the coinage of gold pieces of 20 francs, the standard of which was also 900. A subsequent law, the result of the recommendations of a committee appointed by the French Senate, directed, on the 25th of May, 1864, that pieces of 50 and 20 centimes should be of standard 835; and on the 14th of July, 1866, the standard of fineness of pieces of one and two francs was also reduced to 835.† By the Monetary Convention of the 23rd December, 1865, concluded between France, Belgium, Italy, and Switzerland, the standards of fineness above described were adhered to. Several other countries, notably Roumania, Servia, Greece, Scandinavia, and most of republics of South America, have partially adopted the same monetary system. In Germany, in virtue of the laws of the 4th of December, 1871, and the 9th of July, 1873, the standard fineness of both gold and silver has been fixed at 900. In the United States of America the use of the alloy 900 fine has been confirmed, for both gold and silver, by the Coinage Act of the 12th of February, 1873.

It will be evident, from the foregoing remarks, that the two really important alloys used for the coinage of gold have respectively the standard fineness 916·6 and 900, while for silver coins

* Much information of interest relative to the standard fineness of coins of the 17th and 18th centuries will be found in the "Traité des Monnaies d'or et d'argent, examinées sur les rapports du poids, du titre, et de la valeur réelle," par P. F. Bonneville. Paris, 1806.

† *Annuaire publié par le Bureau des Longitudes*, 1884, p. 292, *et seq.*

* *Op. cit.*, t. i., p. 292, *et seq.*

† King's state of the Protestants in Ireland, quoted in an essay on Irish coins by James Simon, F.R.S., p. 62, Dublin, 1749.

the standard 900 is now more widely used than any other, England alone employing 925, which still maintains the connection with Saxon coins.

In concluding this portion of the subject, it will be sufficient to examine briefly a few other standards of fineness, which either may be actually struck at the present time, or the circulation of which is permitted by the legal enactments of certain countries.* First, as regards gold, the richest gold alloy which survives to the present day would appear to be the gold ducat of the Austro-Hungarian Empire, which, in accordance with the laws of the 24th December, 1867, and the 9th of March, 1870, contains no less than 986 parts of fine gold in 1,000. The issue of gold ducats of fineness 983 is permitted in the Netherlands, by laws of 26th November, 1847, and 6th June, 1875. The poorest gold alloy in circulation appears to be that employed for certain Egyptian coins, the standard of which is only 875, and the same standard is also used for gold coins in Mexico, and in the Philippine Islands.

In the case of silver, the variations are greater. Since 1868, Austro-Hungary has issued kreutzers which contain, respectively, 400 and 500 parts of fine silver in 1,000. The 10 öre piece of Norway also contains only 400 parts of fine silver. The standard of the silver coins of Brazil is 917; the silver coins of British India are 916.6. In Russia, the roubles are of standard 868, while that of the Turkish piastre is 830. In the Netherlands, for pieces of $\frac{1}{2}$ to $2\frac{1}{2}$ florins, the standard 945, which is the richest alloy of silver actually in circulation, is employed; and the standard 720 is employed for the currency of Java, because it is the most homogenous of all the silver-copper alloys.†

The alloys to which reference has hitherto been made, have been simple ones of two metals. In the case of gold coins, the second metal contemplated by law was copper, but silver was, in many cases, used, either to the exclusion of copper, or in conjunction with it. The Australian gold coins first issued contained a considerable proportion of silver, as their colour showed, but in all the examples given the use of triple alloys has rather been the result of accident than of design. It will now be necessary to con-

sider triple or complex alloys at some length. In early times, when complex ores were treated by metallurgists who may have possessed considerable skill, without knowing how to isolate each of the metals present in the ore, singular admixtures have been obtained as the result of the operation. A very experienced copper smelter, Mr. Tyrell, of Swansea, has shown* that it is only necessary to smelt copper pyrites with a small addition of an ore which contains tin, in order to obtain bronze of the composition frequently met with in ancient implements or weapons. Numerous instances of the involuntary use of complex alloys for coinage might be given, but the best example is probably presented by the coins of the early Britons, which were of copper alloyed with 20 to 25 per cent. of zinc and 5 to 11 per cent. of silver, together with small quantities of gold, lead, and tin. Mr. John Evans has pointed out that the Saxon stycas range through a wide field of alloys, and may in some cases have been formed by melting together the coins discovered in "hoards" of Roman coins with, of course, very variable results.† In the case of gold, such triple alloys have been used but seldom. A modern instance in which their use was suggested is presented by the triple alloys of gold, copper, and zinc, prepared in 1873, by M. Péligré.‡ He showed that an alloy containing 58.1 per cent. of gold, 36.1 of copper, and 5.8 of zinc is of good colour, can be readily worked, and possesses the advantage of being decimal as to weight. Péligré also suggested the use of three alloys of silver, copper, and zinc, containing respectively 5, 10, and 7.2 per cent. of zinc, and 90, 80, and 83.5 per cent. of silver, the rest being, in each case, copper; and he also described three simple alloys of silver and zinc, containing respectively 5, 10, and 20 per cent. of zinc.§ I have prepared several of the alloys, and entirely confirm his observations respecting them. The alloy of standard 900, used in France, when melted with 78 grammes of zinc per kilogramme, yields an alloy containing—

83.5 of silver.
9.3 " copper.
7.2 " zinc.
100.0

* An excellent classification of the alloys used in different countries will be found in "La Question Monétaire," par M. H. Costes, Paris, 1884.

† *Levol. Ann. Chim. et Phys.* [3] t. xxxvi., Roberts. Proc. Roy. Soc. v. xxiii. p. 481, 1875.

* Paper published by the Swansea Scientific Society. Session 1880-1.

† Presidential Address, Numismatic Society, 1880, and *Numismatic Chronicle* [3], vol. iii., p. 26.

‡ "Comptes Rendus," t. lxxvi., p. 1,441.

§ *Loc. cit.*, p. 645. 1864.



which is whiter and more malleable than the alloy used for the subsidiary coins. Certain coins struck at Alexandria, in the 3rd century,* contained—

91·38 of copper.
3·85 „ tin and traces of lead.
2·89 „ zinc.
1·81 „ silver.

99·93

The Japanese employ, for the purposes of ornament or currency, several such alloys. The Nebus, now withdrawn from circulation, contained 22·75 per cent. of gold, 76·00 of silver, and 1·25 of copper, and I am informed by Mr. Tookey, who was formerly assayer in the Imperial Mint at Osaka, that the composition of these coins was extremely uniform. It is to be regretted that they were extensively and successfully counterfeited by western visitants to Japan, in an alloy which contained, when melted, only 0·47 per cent. of gold.

Triple alloys, in which silver is the main constituent, have often been used. A singular alloy of silver, copper, and zinc, has been extensively employed in Switzerland for the manufacture of subsidiary coins. A very low alloy of silver and copper has long been employed for coins of small value; such an alloy is called *billon*, and was formerly widely adopted on the Continent generally in modern as well as ancient times. The precious metal contained in the mass is not present in sufficient quantity to give the alloy the colour of silver, and, therefore, the copper is removed by the action of a solvent from the surface of the “blanks” before they are coined, but this layer of silver soon wears off when in circulation, and the coins assume the normal tint of the alloy from which they are made.

The advantage of employing precious metal in this way consists in the possibility of striking subsidiary coins of some value, but of comparatively small weight; the objections to the use of such metal are numerous, and were well expressed in 1790 by M. Gabriel de Cussy,† who pointed out that the manufacture of such coins was expensive, that when withdrawn from circulation they are very difficult to refine, and, finally, they may very easily be counterfeited in alloys which contain no precious metal whatever. Much force was imparted to this latter objection by the statement that one-third of the *billon* then in circulation in France was either of foreign

origin or spurious. The use of such coins of *billon* still lingers in Europe, but as M. Mirabeau said, in a speech delivered before the National Assembly of France in 1790, to which I have already referred, this “detestable money” should be abolished, if only because “a false coiner, with less than 20 sols, can counterfeit 12 livres at a profit of 1,100 per cent.”* The base alloy he had in view contained only one-sixth of its weight of silver, the rest being copper. He appears, however, to have advocated the use of an alloy of about equal parts of silver and copper, and pieces of 15 and 30 sous, of standard fineness 667, were struck in 1791.

The alloy next in importance to those we have hitherto considered is bronze, which, as has already been stated, played an important part in ancient currency. Its modern use on an extended scale is due to the Government of the late Emperor of the French, Napoleon III., by whose direction the old sous circulating in France afforded the basis for a triple alloy, containing ninety-five parts of copper, four of tin, and one of zinc, the weights of the respective coins of one to ten centimes being a gramme for each centime. The law regulating this coinage was passed by the Assembly in May, 1852, and the issue of bronze from that time up to the year 1868 amounted to no less than 59,300,000 francs. All the facts connected with this coinage have been elaborately described by M. Ernest Dumas in a valuable work to which I have before had occasion to refer.† It is an extremely durable alloy, as will be shown in the fourth lecture. Its coinage was undertaken in England in 1861, by the advice of the late Professor Graham, Master of the Mint, and the amount of bronze coin now in circulation is estimated to be about 3,000 tons.

Brass was extensively used by the Romans for subsidiary coins, and, in fact, silver does not appear to have been employed until “the first Punic war, 269 B.C.”‡

Savot mentions the use of a triple alloy of copper, zinc, lead, and a small quantity of tin, to which the name of *potin* was given; and Lenormant states§ that it was only used for money by certain tribes of Gaul, between the wars of Cæsar and the organisation of the

* “Collection Complète des Travaux de M. Mirabeau, l'ainé à l'Assemblée Nationale,” t. v., pp. 25, 8x. Paris, 1792.

† “Notes sur l'émission en France des Monnaies décimales de bronze.” Paris, 1868.

‡ Sir John Lubbock, *Nineteenth Century*, p. 797. November, 1879.

§ Lenormant, loc. cit., t. i., p. 205.

* Lenormant, loc. cit., t. i., p. 205.

† Rapport au Comité des Finances, Paris 1790

Gaulish provinces by Augustus. The coins were always cast, and prove, on analysis, to contain :—

60 of copper.
20 „ lead.
10 „ zinc.
10 „ tin.
<hr/>
100

The use of nickel is extremely ancient. Dr. Walter Flight, F.R.S., has shown* that coins of the 2nd century B.C. were struck in an alloy containing :—

77.585 of copper.
20.038 „ nickel.
0.544 „ cobalt.
1.048 „ iron.
0.038 „ tin.
trace „ silver.
0.090 „ sulphur.
<hr/>
99.343

Pence and half-pence, to the value of £3,000, were coined at the Mint, in the years 1869-71, for use in the colony of Jamaica, of an alloy containing—

75 of copper.
25 „ nickel.
<hr/>
100

but when a further coinage of nickel of the nominal value of £500 was required, Mr. Fremantle reported that the charge to the colony of Jamaica, for the metal alone “would exceed the nominal value of the coin,”† a fact which points to the difficulty of determining the weight that may be safely given to the individual pieces of a token coinage when the metal employed is liable to serious fluctuations in commercial value. Pieces of 5 and 10 centimes of the same alloy, have long been in circulation in Belgium. In Germany also, the pfennige are of this alloy, and it is employed for the subsidiary coinage of Brazil. Certain American nickel coins contain 12 per cent. of nickel, and 88 of copper. The important contributions of Herr Fleitmann to the metal-

* *Numismatic Chronicle*, p. 305, 1868.

† Fourth Annual Report of the Deputy Master of the Mint, p. 11. 1873.

lurgy of nickel have rendered it possible to use the pure metal for coinage, and the 20 rappen pieces of Switzerland, are now struck in nickel without alloy.

The claims of platinum to be used for coinage did not escape M. Rochon,* and the fact is remarkable, considering how comparatively rare the metal was when he wrote in 1786.

With regard to metals which have not as yet been employed for coinage, I would direct your attention to those very light specimen coins of pure aluminium, and of aluminium alloyed with 2 per cent. of nickel, for which I am indebted to the distinguished metallurgist, Mr. G. Matthey, F.R.S.

The points with which we started were, you will remember, that the base metal added to a precious one may be viewed, first, as a useful constituent of an alloy, and, second, as a source of gain. I trust it will have been evident that, within certain limits, the standard selected for the alloy is not a matter of much importance, provided the base metal be added to precious metal in such proportions as to combine the maximum convenience with the best physical properties.

Viewed as a source of gain, it must be borne in mind that “any person” has the right to coin gold, provided the actual manipulation of the precious metal is entrusted to the officers of the Mint, and, as has been well remarked by M. Dalsème, of all its ancient rights the governing body in the State alone preserves the privilege of issuing coins, the intrinsic value of which is slightly less than the value at which they are current, and this right is guarded by law, and exercised in the public interest. In the next lecture, I will attempt to show what precautions are taken to secure accuracy in weight and fineness of the coinage, more especially in the case of the sovereign, which is so widely circulated, and the integrity of which is so implicitly trusted, that it may be said to epitomise the financial honour of the nation.

* *Loc cit.* p. 145.



LECTURE III.—DELIVERED MONDAY, MARCH 31, 1884.

In the last lecture we considered the changes through which the standard fineness of alloys used for coinage have passed in this country since the Norman conquest, and we saw that at a critical period of our numismatic history the silver coins contained only a quarter of their weight of precious metal, and therefore fully justified Latimer's attribution, "Your silver has become dross."

The questions we have now to deal with relate to no violent changes, and do not comprise the history of either national disaster or national success; but they have a certain importance of their own, as they refer to the methods by which standard fineness can be recognised and maintained.

The want of a method for ascertaining the degree of purity of gold and silver, or for determining the amount of precious metals present in their alloys, must have been felt as soon as the use of metals for currency was established. The history of assaying has yet to be written, but in rapidly reviewing the methods of assay which have been practised or proposed, it will be well to consider them in an order that is in the main chronological, but which enables the physical methods, as distinguished from the chemical, to be dealt with first.

The nation for which the honour of striking the first coins is claimed, gave its name to the "Lydian stone," or, as it is called in more recent times, the "touchstone." It is a dark basaltic rock, of fine texture, upon which a fragment of precious metal readily leaves a streak when drawn over its surface. The

comparison of the streak left by the gold to be tested with similar traces derived from alloys of known standard and composition, afforded a ready means of ascertaining, approximately, the fineness of the metal under examination; while further insight into the character of the alloy was gained by submitting the streaks to the solvent action of an acid. There is an abundant literature* showing the degree of accuracy that may be attained by means of this stone; its use has survived for approximate assays until the present day.

Then, again, there was the method of ascertaining the purity of metals by their density, as compared with that of water, devised by Archimedes, B.C., 212, which is applicable to both gold and silver, and is still often resorted to when the metal to be examined must be preserved intact. The usefulness of density, as affording a trustworthy indication of standard fineness, has often been pointed out, notably by W. Symonds,† in 1756, and more recently by Dr. O. Broch.‡

The possibility of ascertaining the standard fineness of alloys by the aid of electricity long ago occupied the attention of physicists. In 1823, Becquerel § suggested that trustworthy indications might be afforded by the electromotive force developed when the alloy to be

* "De re Metallica," by George Agricola. Lazarus Erckern's work, translated by Sir John Pettus, 1683, chap. ix., p. 130.

† Essay on the weighing of gold, &c. London, 1756.

‡ "Norwegian Nyt. Mag. fur Naturvsk," Christiania 1876.

§ "Ann. de Chim. et de Phys.," vol. xxiv., p. 343.

tested is placed in an exciting fluid together with an alloy of known composition. The subject was partially investigated by Oersted,* in 1828, and its practical importance was further pointed out by Gay-Lussac,† in 1830. In 1878, the use of magnetic induction for indicating the composition of alloys was suggested by Professor Hughes,‡ who showed incidentally that the induction balance affords a ready means for detecting counterfeits, and I have elsewhere pointed out the degree of accuracy of which this instrument is susceptible.§ The method which involves the use of the spectroscope also deserves mention here, although it is, as yet, more delicate than trustworthy.||

These physical methods, both ancient and modern, are open to the objection that the uncertainty of the results they afford increases with the complexity of the alloys under examination; and further, the indications are complicated by changes in the physical state of the metals, produced either by hammering or annealing.

Pliny states that in his time a method was in use for estimating the amount of silver in an alloy of silver and copper, by the degree of discolouration or blackening which attends the heating of the alloy in air. This method, long practised in France, and known by the name of *essais à la raclure* (scrapings), or *à l'échoppe*, is described by Rochon,¶ who says that it was generally recognised in the Roman mints in the time of Marius Gratidianus, triumvir of the money, and later by Chaudet,** who gives a table showing that silver of the English standard (925), when heated to low redness in a muffle, becomes uniformly grey-white, while intermediate tints are produced by heating lower alloys, until the standard used for the French subsidiary coinage (835) is reached. As this becomes quite black under the treatment, the process ceases to be useful for alloys of lower standard.

In very early times, the need must have been felt of some chemical method of isolating the precious metals—of separating them, that is, from their base associates, so that the gold or silver, when purified, could be weighed, and the

amount originally present in the mass deduced by calculation.

The crude method of assay, already described, which depends on the change of colour produced by oxidation of the baser constituent of an alloy, leads up to the method used from very early times, which also depends on the principle that precious metals will resist oxidation, while the metals with which they are usually associated will not.

Its main outlines may be indicated as follows. When lead is melted with free access of air, a readily fusible substance forms upon its surface. This substance may be allowed to flow away, or, if the metal is contained in a suitable porous receptacle, called a cupel, the fusible oxide sinks into this containing vessel; in either case the oxidation of the lead affords a means of separating it from precious or inoxidisable metals, if any be originally present in the lead. I found lead in the ancient ornaments both of gold and silver, which Dr. Schliemann permitted me to analyse, and Pliny teaches that the Roman metallurgist used lead for the purification of gold and silver, for he says, "*excoqui non potest, nisi cum plumbo nigro aut cum vena plumbi.*" The greatest of the early alchemists, Geber, who died in A.D. 777, knew perfectly that the lead "acquired a new weight" when heated in air, and I have elsewhere* tried to show how important the recognition of this fact was to the whole fabric of modern chemistry; it is not a little interesting that, among the very first experiments recorded by our own Royal Society, is a metallurgical series relating to the weight of lead increased in the fire on the "copels" at the assay office in the Tower, the account being brought in by Lord Brouncker, in February, 1661.†

The interest of the art of assaying, from a purely scientific point of view, was generally admitted in the 17th century. Lazarus Erckern, for instance, described it as "the very inlet and mother of many other honourable and profitable sciences," while William Badrock,‡ apparently regarding the art as an element of general culture, pleads its claims to be studied by "all gentlemen."

Having shown the great amount of interest attached to the subject, I will now return to

* *Ibid.*, vol. xxxix., p. 274.

† Instruction sur l'Essai des Matières d'Argent par la voie Humide.

‡ Proc. Roy. Soc., vol. xxix., p. 56.

§ *Ibid.* and Phil. Mag. [5], vol. viii., p. 50. Tenth Ann. Report of the Mint, p. 46. 1879.

|| Phil. Trans. Royal Society, vol. clxiv., p. 495. 1874.

¶ Essais sur les Monnoies, p. 17. 1792.

** L'Art de l'Essayeur, p. 77. Paris, 1835.

* Introductory lecture to the course of Metallurgy at the Royal School of Mines, Session 1880-81.

† M.S. Register Book of the Royal Society.

‡ Author of a "New Touchstone for Gold and Silver wares," p. 31. London: 1679.





THE ALCHEMIST.

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the actual practice of the art as a metallurgical operation.

Geber, the Arabian, gives, if medieval translations of his works are to be trusted,* a sufficiently accurate description of the process to enable it to be conducted at the present day with no other aid than his; but it must be remembered that it was the object of the alchemist to distinguish silver from gold, and to isolate the metals, rather than to determine the amount of one metal present in admixture with another. Geber calls the process of cupellation the trial of the *cineritium*, and he points out, in the course of a description that deserves to be reproduced here, that "there are two bodies perfect, abiding the trial, to wit, *sol* (gold), and *luna* (silver). Take," he says, "sifted ashes or calx, or powder of bones of animals calcined . . . moistened with water, and make the mixture firm and solid with your hands, and, in the midst of it, worked into a round flattish lump, make a round and smooth hollowness, and upon the bottom of it strew a small quantity of glass beaten to powder, which lay to dry. When dry, put your metal into the hollowness thereof, which you would try to prove, put coals of fire upon it, then blow with bellows upon the surface till the metal flows: upon which, being in flux, cast part after part of lead, and blow with a flame of strong ignition;" this is to be continued "until the lead is vanished," and precious metal is left "still or quiet, and you see it clean and clear in its superficies," that is, the lead has dissolved the oxides of the base metals, and has carried them into the cupel, leaving the gold or silver, or an alloy of both, in the form of a button on the cupel.

This operation, as described by Geber, would more nearly correspond to a refining operation conducted on a large scale, with a view to the extraction of silver from lead, rather than to the method of assay as practised at the present day on a few grains of metal.

The method of conducting assays, on what would at the present day be considered to be a very large sample of metal, seems to have been held to be necessary in the 12th century, for in the official trials of the coin in the time of King Henry II., 1154-89, the "Miles Argentarius" and the "Fusor"† are instructed to take before the Barons of the

Exchequer a pound of "twenty solidi" of the coin, which they are to place on a "*vasculum ignitorum cinerum quod in fornace est.*" The metal resulting from the trial is then weighed, and the amount it has lost is noted, and, if it is considered that the result of the trial is inaccurate, or "too much metal has been lost, say by the boiling, or by being carried off in the lead," [*illud quasi plus justo consumptum fuerit ignis scilicet exastuatione vel plumbi infusione*], then it is to be repeated.

The amount of metal which has, for at least two centuries, been taken for assay is 12 grains troy, and this weight, which is known as the "assayer's pound," has the same number of divisions as the troy pound; the fineness of any given weight of metal is, therefore, indicated by the results of an assay, without tedious calculation. It has been shown that the process was officially recognised in this country in the reign of Henry II., and in France the first official mention of it occurs about the year 1314. It is the only method of assaying silver practised at the present day in the English Mint, although another method is used for verifying the composition of its alloys.

With regard to the apparatus required:—In Geber's work "of furnaces" there is no mention or illustration of the "muffle" furnace, so that he seems to have conducted the process in a cupel surrounded by incandescent fuel.

Biringuccio (1540) gives illustrations and detailed descriptions of appliances which hardly differ from those now in use, and so does his contemporary Agricola.* Budeliust† (1591) gives a drawing of a furnace which somewhat resembles the type still used in continental mints, except that the muffle, or oven, is placed close to the base of the furnace; and the "Sculptures" of Sir John Pettus, reproduced from the works of Lazarus Eckern,‡ show various forms of muffles and furnaces, some used by the ancient assayers, others adopted in the middle of the 17th century at Nuremberg, where the goldsmiths flourished so vigorously. He also gives an improved form of furnace, "made of armour plates," closely corresponding in its general arrangement with a furnace now lent by the Mint to the science collection at South Kensington, which is specially interesting, as tradition points

* There is a good English edition of the 17th century, "The Works of Geber," translated by R. Russell. 1686.

† Quoted by Lowndes, "Essay for the Amendment of the Silver Coins," p. 135 (London, 1695.), from the Hack Book of the Exchequer, written in the time of Henry II., cap. 21, *Officium Milites Argentarii et Fusoris*.

* "De re Metallica."

† "De Moneta et Re Numaria, Coloniae Agrippae." 1591.

‡ Op. cit., p. 17.

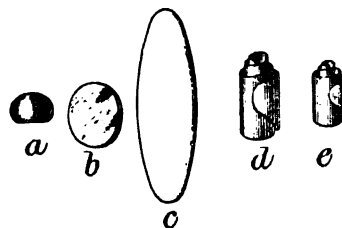
to it as being the furnace used by Sir Isaac Newton in his experiments on cupellation when Master of the Mint. Several transitional forms of furnace between the old one just mentioned and those now used by the Mint* are still preserved in the Assay-office. The tongs and other tools incidentally used do not require special notice, as the changes that have from time been made in them have only rendered their forms more delicate and handy, and have hardly altered their general type.

With regard to the balances employed, it may be sufficient to point out that, for centuries, they have been constructed with great delicacy, and that they now turn with $\frac{2}{1000}$ ths of a grain, when loaded with 10 grains. In fact, the use of the balance in very early times, for the purpose of assay, absolutely demolishes the claim of quantitative chemistry to be considered of comparatively modern origin. The indications afforded by the balance as to the result of an assay are not absolute, as the process is liable to error from several sources, and needs to be controlled in the manner, which will be described subsequently.

The point to bear in mind at this moment is, that if the silver has been associated only with readily oxidisable metals, especially copper, as is usually the case when silver coins are assayed, then it only becomes a question of providing the amount of lead necessary to furnish, by oxidation, sufficient litharge to dissolve the oxides and carry them away. If, however, the silver is associated with gold, the latter metal resists oxidation, and will remain on the cupel with the silver, for—again to quote Geber—it will in “nowise forsake it.” The cupellation stage must then be supplemented by a “parting” operation, that is, the silver must be dissolved away by some solvent which will leave the gold untouched, and for this purpose nitric acid is universally employed. If the silver contains but a minute quantity of gold, the presence of the latter will be indicated by a few specks of brown powder left at the bottom of the vessel in which the silver is dissolved; if, however, the silver contains about one-third of its mass of gold, and has been extended into a strip, the gold will remain after the action of the acid, as a coherent band, retaining the original form of the strip, but much reduced in volume. This action of nitric acid on an alloy of gold and silver was certainly known to Geber and the early alchemists, but the first

official mention of the use of the parting assay appears to be in a decree of Philippe de Valois,* in the year 1343, confirming its use in the French Mint. The assay methods for silver and gold are analogous, in so far that both are purified by the action of a solvent, but the base metals are removed from silver by fused litharge, while in its turn silver is parted from gold by nitric acid. There is, then, this difference between the assay of gold and silver. In the case of the cupellation assay of silver, the button of metal has only to be removed from the cupel, and when the adhering bone ash has been removed by a brush, it passes direct to the balance. The process would also be sufficient for gold, if it contained no other precious metal; when, however, the problem is to ascertain by assay how much gold is contained in an alloy, which may contain silver, or platinum and other metals of similar properties, then care must be taken that the amount of gold believed to be present in the alloy does not exceed the one-third part of the mass, as a larger proportion of gold would protect the alloy from the solvent action of the acid, and the greater the amount of gold, the less perfect would be the attack of the acid.

In any case the first stage of assaying a gold alloy, say a sovereign, is to melt it with such an amount of silver as shall yield a button containing rather less than one-third of its weight of gold.



Scale about $\frac{1}{2}$.

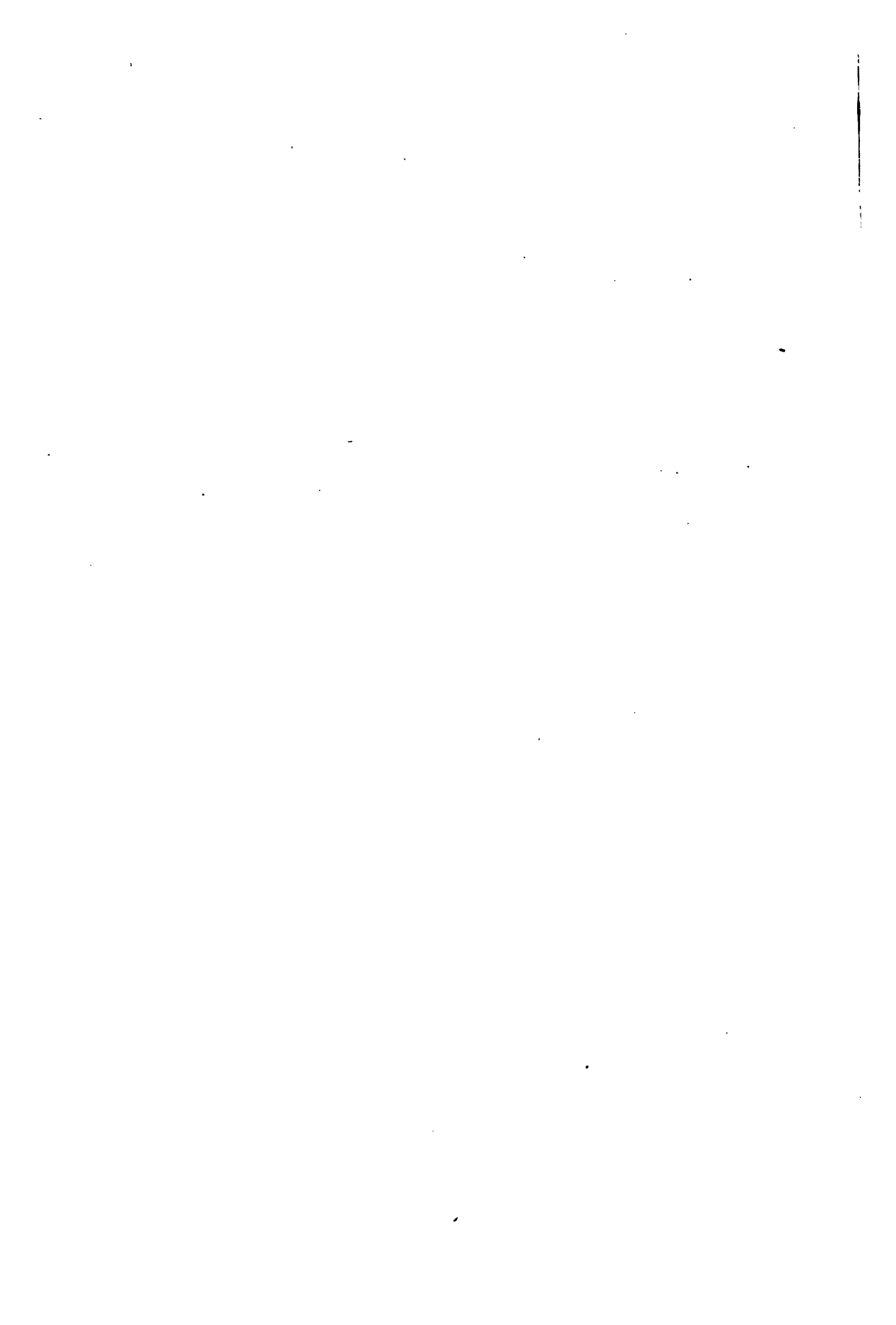
For the sake of convenience, and for the incidental advantage that the solvent action of fused litharge removes copper and other impurities, the first stage of the assay of gold is conducted on a cupel, the object to be attained being mainly to secure a button (a) of gold and silver in a convenient form for submitting to the subsequent operations. The alloying stage would, however, be just as effective if it were conducted in a small non-porous receptacle, such as a small crucible of glazed porcelain.

The subsequent operations are, flattening the button (b), annealing it, rolling it into a strip (c),

* A drawing of the modern furnace was prepared for Dr. Percy's work, "Silver and Gold." Part I., p. 256. 1880.

* Boizard, "Traite des Monnoies," p. 176. 1692.





and annealing it a second time. It is then coiled into a spiral, or cornet (*d*), and treated by two successive portions of nitric acid, in order to remove the silver; after this the spiral of spongy gold (*e*), which retains the original form given to the silver-gold alloy, is heated to redness, when it becomes bright, and is sometimes so coherent that it may be unrolled without fracture.

This is an outline of the processes of assaying; the precautions which are adopted with a view to secure accuracy remain to be considered. Inaccuracy in silver assaying mainly arises from loss of silver, which may disappear in small but variable quantities, either by volatilisation or by sinking into the cupel with the litharge. The amount of metal lost varies with the temperature, which is never uniform throughout the muffle; and the results of assays, as indicated by the balance, have, therefore, to be controlled by assays on pieces of metal of known standard, distributed in such a way as to represent the varying degrees of temperature throughout the muffle. The metal lost by any given check-piece is added to the assays in close proximity to it, and, as the amount of metal lost very often amounts to $1\frac{1}{4}$ per cent., the apportioning of the additions to be made demands great skill on the part of the assayer, who has also to decide from the appearance of the buttons whether they have retained lead or not, in which case they would, of course, be unduly heavy. In gold assaying, on the other hand, although as Geber knew, gold resists the action of molten litharge better than silver does, some precious metal may be lost either by volatilisation, or by retention in the cupel, but the chief sources of error are (1st), solution of gold in the acid used, which would reduce the weight of the cornets, and (2nd), retention of silver by the cornets; but these inverse causes of error may be combined, without neutralising each other. Some means of checking the results must, therefore, be provided, and it would appear that for centuries implicit confidence has not been placed in the indications afforded solely by the assays, as comparisons have invariably been instituted between the pieces of metal taken for assays, and standard trial plates, or pieces of known composition, assayed side by side with the coins, so that any error affecting the coin assays also affects the check pieces, and, therefore, the error can be allowed for.

The trial plates by which silver and gold coin have been tested, possess, it seems to me, an amount of interest that can hardly be over-

rated. The oldest of them to which a date can be assigned, is a silver-plate, imperfectly impressed with the dies of a coin of the time of Henry III. (1216-1272). A silver plate is alluded to as follows, in the *Rotulus de Moneta*, of the 7th and 8th years of King Edward I.:—"Premerement qe hom doit fere un estandard, qe doit demorer al Eschequer, ou en quel lieu qe nostre seignor le Roy vodra," and in 1326 there is a record of the provision of two silver-plates for testing the silver coined by King Edward II., for his Duchy of Aquitaine, "one plate to be of the just weight before the fire, and the other such as it (the metal tested) ought to be after the assays."* This is interesting, because it seems to point to the fact that the amount of silver which should be "lost in the fire," had been experimentally determined at that early period. Many of the old trial plates were formerly kept in the Pyx Chapel Abbey, Westminster Abbey, almost the only relic which remains of the church built by Edward the Confessor, and on the altar tomb believed to be that of Hugolin the first Chancellor of the Exchequer, there is a circular dish-shaped cavity on which a small furnace may have rested, if,† as is probable, the trial of the Pyx was at one time conducted in this building. The trial plates were removed in 1842 from the Pyx Chapel to the office of the Queen's Assay Master in the Mint; and I am fortunate in being able to offer to the Society photographs of some of the more interesting of these.‡ The trial plates were always divided into several portions, and, like the old Exchequer "tallies," this division was effected in rough serrations, so that portions of the original plate entrusted to the different officers, could be readily identified. A table, showing the composition of these ancient trial plates, is appended to this lecture, and I will only add here that most of the standards shown in the diagram § are represented in the Mint collection. Of those which are photographed, the more interesting are probably No. 1, made in the 17th year of King Edward IV. (1477), and No. 2, which marks the introduction of the standard now in use, 916.6, by King Henry VIII. All the plates, however, possess peculiar interest, for in relation to the assays of the "alloys used for coinage," they are the signs

* "Ruding," vol. 1, p. 209.

† "Notes and Queries," Nos. 17, 19, 20 and 23. 1880.

‡ These are issued as a Supplement to the present *Journal*. The photographs were prepared by the Autotype Company, and have been reproduced by the "Ink-photo" process of Messrs. Sprague.

§ See second lecture, p. 19.

of centuries of responsibilities, which I am fully sensible it is a privilege to be permitted to sustain.

An examination of a series of assays made of the trial plates shows that, although the standards of fineness were always prescribed by law, the plates have, nevertheless, at times been very inaccurate.

The imperfections of the gold plates are mainly due to sources of error which had been recognised, but which were ignored when the last plates were made; and it is well to explain, therefore, that plates were, in former times, authoritatively pronounced to be "standard" simply with reference to the results of an inaccurate process of assay. The process now consists in submitting an accurately weighed portion of the alloy to a rapid method of chemical analysis, whereby impurities are eliminated, and the precious metal, thus purified, is again weighed, but the method is complicated, and the accuracy of the result may be affected by the retention of impurities, or by an actual loss of metal during the process. The weight of gold as indicated by the balance will, in consequence, not represent the amount originally present in the alloy, and it is, therefore, necessary to control the results by assaying, side by side with the alloys under examination, "standards" or check-pieces the composition of which is known. As, however, any error in the composition of these checks will be reflected in the result of the assay, it is preferable to use pieces of pure metal corresponding in weight to the amount which the alloys to be tested are anticipated to contain.*

* The corrections to be applied to a gold assay will be readily understood from the following formula:—

Let 1,000 be the weight of alloy originally taken;

ϕ . The weight of the piece of gold finally obtained;

x . The actual amount of gold in the alloy expressed in thousandths;

a . The weight of gold (supposed to be absolutely pure) taken as a check, which approximately equals x ;

δ . Loss or gain in weight experienced by (a) during the process of assay;

k . Variation of "check gold" from absolute purity, expressed in thousandths;

Then the actual amount of fine gold in the check-piece

$$= a \left(1 - \frac{k}{1000} \right), \text{ and the corrected weight will be } x = \phi$$

— $\frac{a k}{1000} + \delta$, (δ) being added or subtracted according as it is a loss or gain.

If (a) be assumed to be equal to (x) this equation becomes

$$= \frac{\phi + \delta}{1 + \frac{k}{1000}}$$

Formerly, such checks of pure metal were not employed, and a small amount of silver varying from $\frac{1}{10000}$ th to $\frac{1}{1000}$ th part of the initial weight of the assay piece which remained in association with the gold was consequently reckoned as gold in the assay report. It follows, therefore, that even the more recent plates, when accurately assayed, are usually found to be sensibly below the exact standards which they were intended to represent.

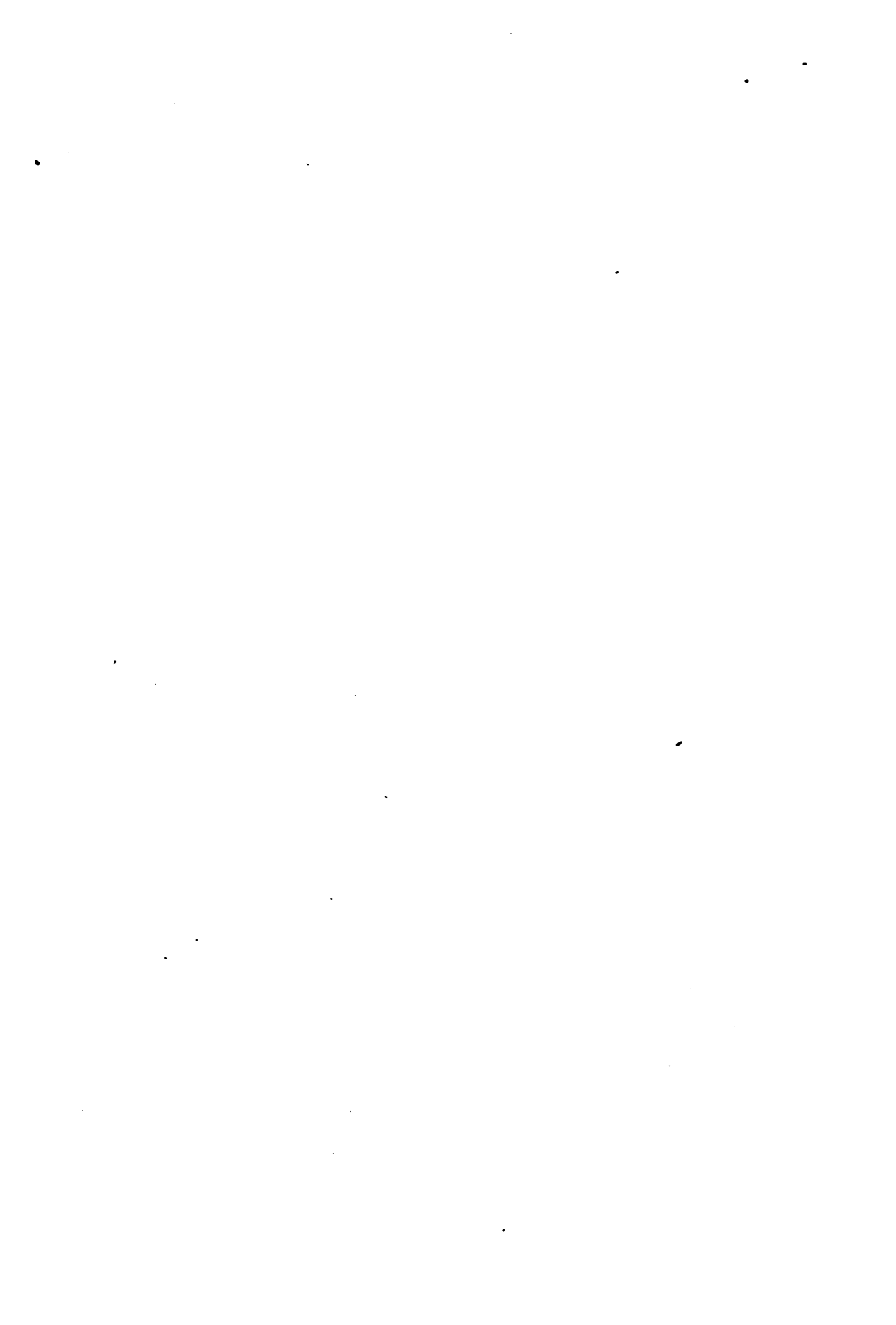
The experiments made with a view to ascertain the composition of the standard gold plate prepared by me in 1873, show that the greatest variation of this plate from the exact standard does not exceed the $\frac{1}{10000}$ th part; but the use of even a fairly accurate standard plate is liable to be attended with error, as the actual amount of precious metal in the amount taken for the check-piece may exceed or fall short of the true standard. It follows, therefore, that the assay reports on portions of metal tested by comparison with this check may indicate the presence of too little or too much precious metal.

The objections to the use of a standard silver plate are far greater, as the alloys used for the silver coinage, in this and in other countries, are mechanical mixtures, the molecular arrangements of which are very peculiar, and so far as my experience goes, a plate of the legal standard cannot be prepared of uniform composition.

With regard to the use of pure gold and silver plates, it should be pointed out that, if it were possible to obtain gold and silver of absolute purity, there would be no limits to accuracy in assaying, except such as arise from operations of a purely mechanical nature. Of course, it is not possible to attain to chemical purity, and the presence of traces of impurity in the checks causes the results of assays made in comparison with them to indicate the presence of an amount of pure metal in excess of that actually present in the alloy; but as the converse can never be the case, that is to say, as the gold cannot be more than pure, no danger can arise from this cause, and the error can be easily allowed for.

The supplementary fine gold and silver plates, prepared in accordance with instructions I received from the Lords Commissioners of the Treasury in 1872, proved eminently satisfactory. I have not been able to prepare, or to obtain from any source, gold of greater purity, even in small quantities. The silver plate leaves little to be desired, although it is





not quite as pure as silver prepared by M. Stas, in comparison with which it is as 999.95 to 1,000.

In conducting official trials of the pyx, minute accuracy is secured by a final appeal from the standard plates themselves to pure gold or pure silver.

We are now in a position to consider another question, the importance of which has long been recognised by law, and that is, the difficulty of attaining an exact standard, either of weight or fineness, in the case of all the individual coins issued from a mint. The law has for centuries, and in all nations, permitted a certain deviation from the exact standard. The amount of such "remedy," as it has always been termed in this country, has changed from time to time, but has gradually diminished as the art of coining has advanced.

It follows, that although the component parts of the alloy may not bear to each other with mathematical precision the proportion prescribed by the regulations under which they are manufactured, they may, nevertheless, be considered to be of standard fineness. The earliest reference to a "remedy" I have met with is in the reign of Saint Louis, of France, 1253,* who granted an allowance of $\frac{1}{4}$ carat, for the fineness of Louis d'or. The Mint agreement between King Edward I., and William de Turnemire,† in 1279, provides a remedy of $2\frac{1}{2}$ dwts. on the pound troy of the silver coins. The law does not appear to have contemplated that the "remedy" should be systematically made use of as a source of profit, either to the Crown or to the Master of the Mint; it was rather considered to define the limits within which occasional variations of standard weight were unavoidable, and its true function has been well defined by the late M. de Jacobi, who, representing the Russian Government at the International Monetary Conference, held in Paris, in 1867, said, "the remedy is not an arbitrary stipulation, but is the limit of errors which belongs to every thought, to every chemical analysis, to every composition of alloy, and as such depends on the precision of the balances, and the methods employed in the fabrication of money. It may be determined rigorously by applying the calculus of probabilities."

The Mint indentures have been drawn up in just the same spirit. Remedies were accorded "because the said moneys may not continually be made in all things according to

the right standard, but, peradventure, through default of the master or workers, they shall be found sometye too strong or too feeble in weight or alloy," but this has not prevented a very different view having been taken of the privileges accorded by them, both to the Sovereign on the one hand, and the Master of the Mint on the other. Queen Mary, for instance,* seems to have considered that the Sovereign was entitled to add as much base metal to the coinage as the law permitted, the sum so derived after deducting coinage expenses, to be considered seignorage, but she held that the Crown could not debase the coin, or increase the amount of base metal in it for private ends.

With regard to the action of Mint Masters in this respect, the history of the coinage abundantly proves that they frequently availed themselves of the "remedies," viewing them as a legitimate source of profit, or as a means, incidentally provided by their contracts, for reducing the current expenses of working the best known case being probably that of Lonison, Master of the Mint in the reign of Queen Elizabeth.

The scale of remedies is fixed by the Coinage Act of 1870, at present we will only consider the remedy of fineness, which, in the case of the gold coin, has a range of $+\frac{1}{1000}$ th, and in the case of silver $+\frac{1}{1000}$ th. The gold coins of the nations who have joined the Latin Union have also a remedy of $\frac{1}{1000}$ th. In America, the remedy in the case of the gold coins has been reduced to $\frac{1}{1000}$ th. "I do find," said Rice Vaughan,* writing in 1675, "that some men of great experience and understanding, even in this mechanical part, do hold that the moneys, both of gold and silver, may be made without any remedy to be allowed either for weight or fineness," but he subsequently adds, "I undertook this discourse of the mechanical part of money with scruple, so I do leave it with alacritie." It is certainly not the opinion of Mint officers at the present day that the remedies should be reduced to the lowest possible point, as this would involve the rejection and re-coinage of a large number of pieces before they could be permitted to leave the Mint; but, on the other hand, all agree that a persistent variation, however slight, above or below standard, has never been contemplated by law. The effect of such a mean variation would be remarkable.

If, for instance, the Mint were to issue

* Jean Boizard, "Traite des Monoyes," p. 25, 1692.

† Report on Royal Mint, p. 47, 1849.

* Report on the Royal Mint, p. 39. 1849.

† "Discourse of Coin and Coinage," p. 92. 1675.

sovereigns which were either persistently too rich or too poor in gold, to the extent actually permitted by law, a loss or profit would accrue of over £2,000 on each million coined, and a persistent variation of only $\frac{1}{1000}$ th part would be equivalent to a profit or loss of £100 a million. In Mint practice, at the present day, even this comparatively small variation should be avoided, and the public trials of the pyx prove that it does not exist.

I have dwelt on these facts because the maintenance of rigid accuracy in the operations of coinage becomes of great importance in international currency. One Government might, as the late Professor Stanley Jevons pointed out, "coin money slightly inferior to the proper standard, and such money once introduced would, in virtue of Gresham's law, be difficult to dislodge." I admit, with him,

that it is hardly to be supposed that a State issuing money under international obligations would wish to make a profit of one or two parts in a thousand, which the remedy would legally cover; but nevertheless, the degree of accuracy with which the coinage is executed would be of much importance, for the following reason. A nation would be bound by the International Convention to withdraw and re-coin such coins of other nations as might be circulating within its borders at the time they were reduced by wear below the lowest weight at which their circulation would be legal, and it follows that any deficiency of standard which might exist would have to be made good by the nation on whom the recoinage happened to fall, and a nation coining with rigid accuracy would suffer from the shortcomings of those who did not.

TABLE SHOWING THE COMPOSITION OF THE ANCIENT GOLD TRIAL PLATES, OF WHICH PORTIONS ARE PRESERVED IN THE MINT.

Date.	STANDARD PRESCRIBED BY LAW.		ACTUAL COMPOSITION.	Remedy or permitted variation in carats and in thousandths.	REMARKS.
	In carats and grains.	Decimal equivalent.			
1349				$\frac{1}{2}$ carat or 13'9	Amongst the Cotton Manuscripts is preserved the account of a trial of the pyx of gold nobles in the year 1349. The coins were to be compared with one ounce of florins of Florence, kept in the Treasury as standards.
1477	23 $\frac{3}{8}$	994'8	Gold ... 993'5 Silver ... 5'15 Copper*... 1'35	$\frac{1}{2}$ carat or 5'2	This, the earliest gold Trial Plate of which there is any record, was made in the 17th year Edw. IV. Special legal provisions were enacted for the protection of the coin of the realm, which appears to have been debased in every possible way. When gold coins were first introduced into England by Henry III., in 1257, they were 24 cts. fine, that is, pure gold. Edward III., in 1345, was the first to use the standard of this plate, 23 cts. $\frac{3}{8}$ gra. fine, or 994'8. (See No. 1, Plate I. of photographs.)
1527	22 0	616'6	Gold ... 915'5 Silver ... 78'3 Copper ... 6'2	$\frac{1}{2}$ carat or 6'9	In 1526, Henry VIII. issued a proclamation directing that crowns of the double rose should be coined of the standard 916'6 for concurrent issue with sovereigns and other coins of the original standard of 994'8. This plate was made in the following year. (Photograph No. 2, Plate I.)
Probably 1543	23 0	958'4	Gold ... 954'4 Silver ... 34'8 Copper ... 10'8	$\frac{1}{2}$ carat or 6'9	This plate was probably prepared to correspond with the debasement of standard which took place in this year from 994'8 to 958'4. In 1544, the standard for all gold coins was reduced to 916'6, and again in 1546 to 833'4, the lowest point ever reached in England.
1553	23 $\frac{3}{8}$ [23 10 $\frac{1}{2}$ indenture]	994'8	Gold ... 990'3 Silver ... 9'7 Copper ... —	$\frac{1}{2}$ carat or 6'9	This is the first plate bearing an inscription, which runs as follows:—STAN 9 0 OF 0 XXIII 0 KARE 9 0 X 0 GRE 9 9 DEMI 0 FYNE 9 PRYVE 9 MARKE 9 9. It bears no date, but the "pryve marke" (a pomegranate) is the same as that borne by the sovereigns and "angels" issued by Mary in this year. In a proclamation, dated 1553, it is stated that the coins shall be made of "fine gold," which doubtless, means the old standard of 994'8, which, according to Ruding, was in use in this year. (Photograph No. 3, Plate I.)

* With copper are included any minute quantities of other base metals which may be present.





DATE.	STANDARD PRE- SCRIBED BY LAW.		ACTUAL COMPOSITION.	Remedy or pre- mitted variation in carats and in thousandths.	REMARKS.
	In carats and grains.	Decimal equiv- alent.			
1560	22 0	916'6	Gold ... 913'7 Silver ... 60'8 Copper ... 25'7	½ carat or 6'9	On her accession to the throne in 1558, Elizabeth took active measures to continue the improvements in the standard of the coinage which had been commenced by Edward VI. (Photograph No 4, Plate I.)
1560	23 3½	994'8	Gold ... 994'3 Silver ... 5'7 Copper ... —	½ carat or 5'2	On the 8th November, 1560 (the year in which these plates were made), an indenture was made with Thomas Stanley to coin gold of both standards.
1593	22 0	916'6	Gold ... 915'9 Silver ... 52'1 Copper ... 31'9	½ carat or 6'9	In the 35th year of Elizabeth's reign (1593) a commission was granted to Sir R. Martin to issue coins of the standard 916'6; this plate was, doubtless, made with reference to that coinage.
1605	23 3½	994'8	Gold ... 990'3 Silver ... 8'3 Copper ... 1'4	½ carat or 5'2	In the first two years of his reign (1603-4) James I. issued coins of the standard of the previous plate, namely 916'6. In 1605, however, he raised the standard back to the original 994'8. (Photograph No. 5, Plate I.) A plate of the standard 916'6, dated 19th November, 1604, is mentioned in "Pollett's Abstracts of Pyx verdicts," but no portions of it remain in the Mint.
1649	22 0	916'6	Gold ... 913'0 Silver ... 51'1 Copper ... 35'0	½ carat or 6'9	On the 16th of November, 1649 (the first year of the Commonwealth), an Act of Parliament was passed empowering the council of state to administer an oath to a jury of goldsmiths charged with the preparation of this plate. It was accordingly made on the 20th December following.
1660	23 3½	994'8	Gold ... 990'9 Silver ... 3'7 Copper ... 5'4	½ carat or 6'9	Charles II., soon after his accession, ordered these plates to be prepared, rejecting those made under the Commonwealth, which had only been employed at one trial of the pyx. (Photograph No. 6, Plate I.) With regard to the 994'8 plate, it may be mentioned that no coins appear to have been issued of this composition after the year 1640. No record of the preparation of these plates is preserved at Goldsmiths'-hall.
1660	22 0	916'6	Gold ... 912'9 Silver ... 53'3 Copper ... 33'8	½ carat or 6'9	
1688	22 0	916'6	Gold ... 914'6 Silver } Copper } 85'4	½ carat or 6'9	
1707	22 0	916'6	Gold ... 917'1 Silver ... 59'5 Copper ... 23'4	½ carat or 6'9	This plate appears only to have been used at the trial of the pyx, which took place on the 21st August, 1710. After this it was finally abandoned, probably because it contained too much gold, and was, therefore, to the disadvantage of the Master. At the next trial, on the 7th Aug. 1713, the use of the 1660 and the 1688 plates was resumed, both of which were considerably below standard.
1728	22 0	916'6	Gold ... 916'1 Silver ... 50'4 Copper ... 33'5	½ carat or 6'9	
1829	22 0	916'6	Gold ... 915'3 Silver ... 37'6 Copper ... 46'5	⅙ carat or 2'6	It may be observed that in 1817 an effort was made to attain greater accuracy in the coinage, the remedy being in that year reduced from 6'9 to 2'6 parts in a thousand.

NEW TRIAL PLATE.

1873	22 0	916'6	Gold ... 916'61 Copper ... 83'39	2'0	The standard plate was alloyed with copper only, in order that it might correspond with the composition of the British gold coins. Both plates were prepared at the Mint, and verified by the Goldsmiths' Company, 22nd December, 1873.
1873	Supplementary Plate.		Pure gold.		

TABLE SHOWING THE COMPOSITION OF THE ANCIENT SILVER TRIAL PLATES, OF WHICH PORTIONS ARE PRESERVED IN THE MINT.

Date.	STANDARD PRESCRIBED BY LAW.		ACTUAL COMPOSITION.	Remedy or permitted variation in dwts. and in thousandths.	REMARKS.
	In ozs. and dwts.	Decimal equivalent.			
No date.			Silver ... 757'4 Copper ... 246'6		This plate bears no date, nor is it accompanied by any label, but its form would appear to indicate that it belongs to a very early period. Until the year 1842 the trial plates were kept in the Pyx Chapel, in the cloisters of Westminster Abbey, where certain assay pieces of gold and silver, with ancient memoranda relating to them, were also found. One of these pieces is the extremity of a bar or ingot of silver, which has its upper surface rounded and imperfectly impressed with the dies of a coin of the time of Henry III. (1216-1272.) Mr. Black, formerly Assistant Keeper of the Public Records, considered that this had been employed at the trial of the pyx, and that it is probably the remains of the oldest standard piece which has been preserved. It proved on assay to contain 921'0 of silver and 2'0 of gold, a result which points to its representing the new coinage introduced 1267.
1477	11 2	925'0	Silver ... 923'5 Copper ... 76'5	2 dwts. or 8'4	See No. 1, Plate II. of photographs.
Probably 1527			Silver ... 855'5 Copper ... 114'5		These three earlier plates differ in form from all those which succeed them. They are chisel-shaped, the ends being hammered out apparently in order to receive the impression of a coin. This impression is, however, only preserved on the 1477 plate. There is no record of any coinage having the composition of this plate, but a label is attached to it, bearing the date "13th October 18th Henry VIII." (1527.)
1542	9 6	775'0	Silver ... 763'6 Copper ... 236'4	Probably 3 dwts. or 12'5	Henry VIII. issued in Ireland, in his 33rd year (1542), coins of this standard. Their circulation in England was prohibited, but within four years he reduced the standard in England to 333'3 parts of fine silver in 1,000.
1553	11 2	925'0	Silver ... 927'0 Copper ... 73'0	2 dwts. or 8'4	Mary, on her accession to the throne, issued a proclamation stating that a coinage of "Silver in fineness of the standard sterling" should be commenced; in the indenture, however, of the same date (1553), the composition is fixed at 916'6. (See photograph No. 2, Plate II.) This plate, which bears an inscription similar to that on the gold plate, and the same privy mark (a pomegranate) appears from its inscription, xi oz. Fyne, to have been prepared to correspond with the composition named in the indenture, but I have recently confirmed the accuracy of the assay given (927), and no plate having the composition prescribed in the indenture (916'6) exists in the Mint. Several coinage arrangements introduced by Mary were convenient. The standard of silver was the same as that of gold, and their values, therefore, were easily comparable.
1560	11 2	925'0	Silver ... 930'2 Copper ... 69'8	2 dwts. or 8'4	On the 27th September, 1560, Elizabeth issued a proclamation, stating that "to make an end of all troubles arising from debased monies, Her Majesty had already begun a coinage of fine money in the Tower of London." This plate probably marks the restoration of the old standard, which took place in this reign. (See photograph No. 3, Plate II.) The convenient arrangements introduced by Mary were discontinued, a change which was subsequently regretted by Lord Liverpool, in his letter to George III. (p. 100), as it introduced difficulties in the comparison of the values of gold and silver coin. Had Mary's regulations been allowed to continue, the composition of both gold and silver coins in Great Britain and British India would at the present day have been identical.





ANCIENT GOLD TRIAL PLATES.



3

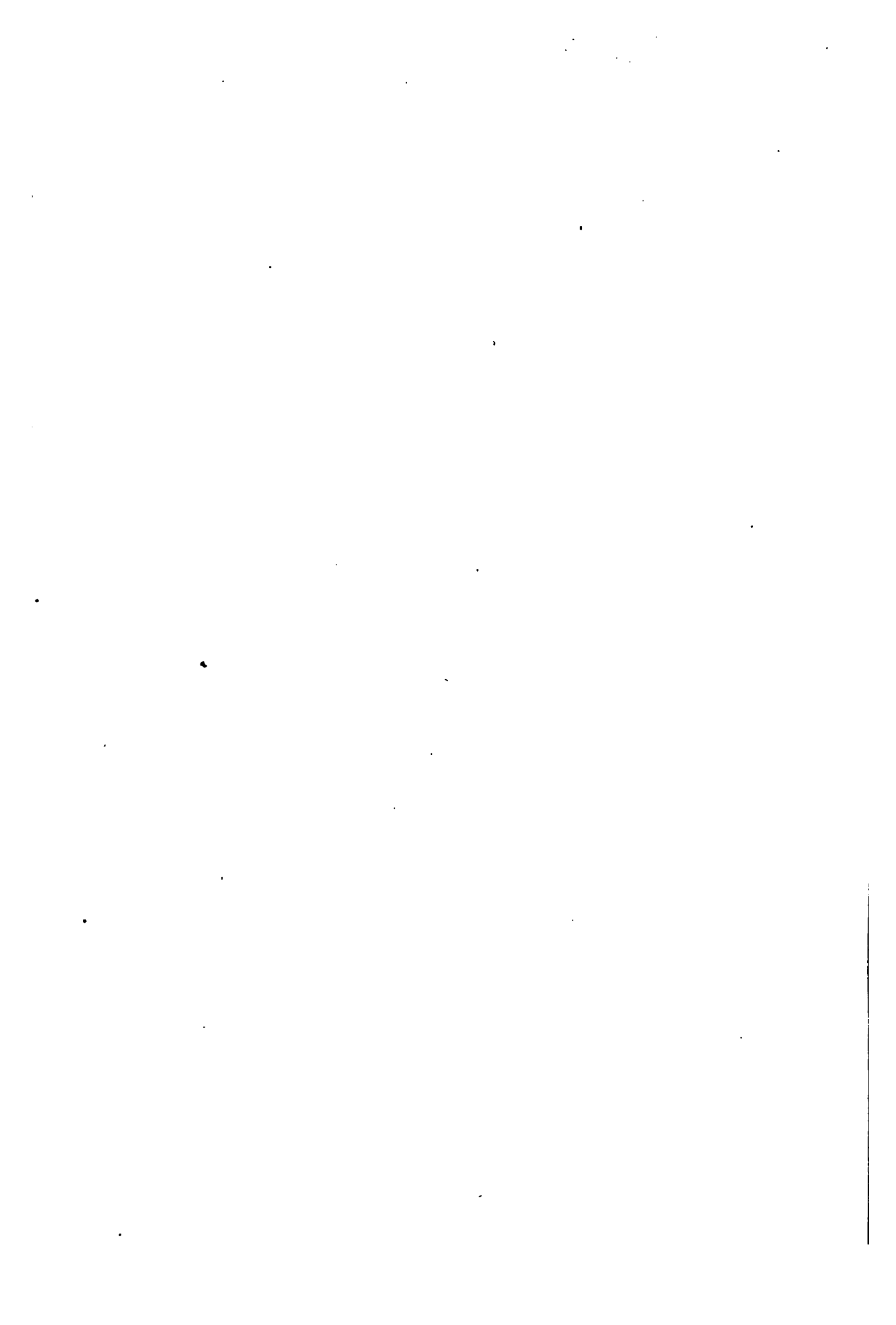
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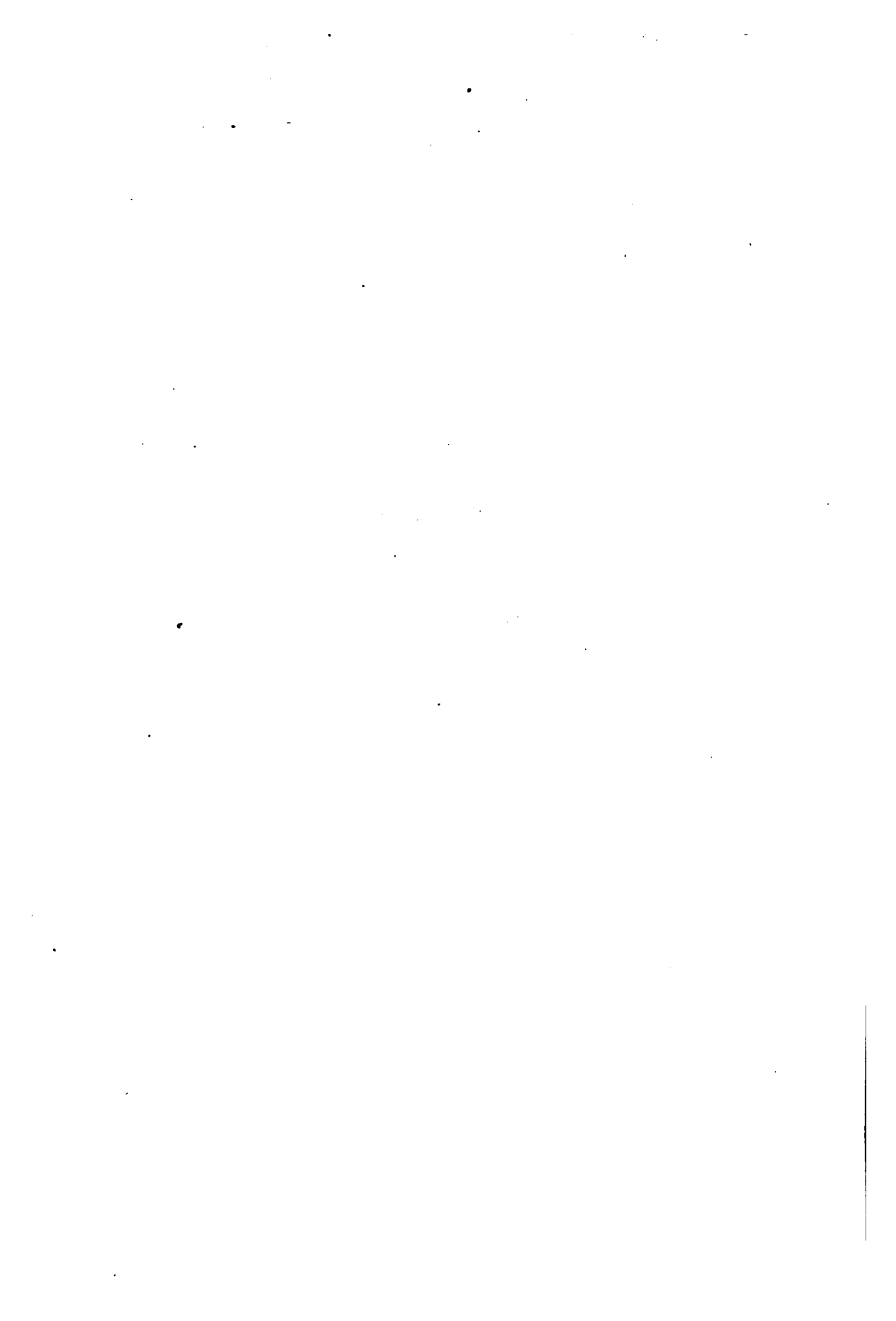




ANCIENT SILVER TRIAL PLATES.



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Date.	STANDARD PRE- SCRIBED BY LAW.		ACTUAL COMPOSITION.	Remedy or per- mitted variation in dwts. and in thousandths.	REMARKS.
	In ozs. and dwts.	Decimal equiva- lent.			
1600	3 0	250'0	Silver ... 252'0 Copper ... 748'0	3 dwts. or 12'5	This plate is labelled "Standard for Ireland, An ^o 1600"; and in 1601 Elizabeth decreed that coins of about this standard should be issued in Ireland, or, as the indenture states, "with such provision and moderation as in former times had not been done, and so as none of our Highness' loving and faithful subjects should be thereby prejudiced." Considering how extremely debased this coinage was, it is difficult to understand these expressions. Simon states that the standard was 241'5, but Malynes fixes it at 250, a statement which is confirmed by the composition of this plate. (See photograph No. 4, Plate II, which, however, only shows part of the trial plate)
1601	11 2	925'0	Silver ... 925'1 Copper ... 74'9	2 dwts. or 8'4	This plate was employed at the trials of the pyx up to the 20th June, 1605, and its composition is very closely in accordance with the true standard. (See photograph No. 5, Plate II.)
1604	11 2	925'0	Silver ... 922'7 Copper ... 77'3	2 dwts. or 8'4	
1649	11 2	925'0	Silver ... 923'7 Copper ... 76'3	2 dwts. or 8'4	The jury of Goldsmiths empanelled to prepare the gold plate on the 16th November, 1649, were also ordered to make this silver plate of the standard 925, to be used as "Standard Trial Pieces." These pieces were "to be indented and printed according to the pleasure of the Parliament."
1660	11 2	925'0	Silver ... 924'2 Copper ... 75'8	2 dwts. or 8'4	As in the case of the gold plates of this date, there is some uncertainty as to where this plate was prepared.
1688	11 2	925'0	Silver ... 922'0 Copper ... 78'0	2 dwts. or 8'4	
1707	11 2	925'0	Silver ... 922'0 Copper ... 78'0	2 dwts. or 8'4	
1728	11 2	925'0	Silver ... 928'9 Copper ... 71'1	2 dwts. or 8'4	
1829	11 2	925'0	Silver ... 925'0 Copper ... 75'0	1 dwt. or 4'2	Prepared by a jury of Goldsmiths, and verified by the King's Assay Master.
NEW TRIAL PLATE.					
1873	11 2	925'0	Silver ... 924'96 Copper ... 75'04	4'0	} Prepared at the Mint, and verified by the Goldsmiths' Company, 22nd December, 1873.
1873	Supplementary Plate.		Pure silver.		

LECTURE IV.—DELIVERED MONDAY, APRIL 7, 1884.

We have now to consider the means adopted to secure accuracy in the weight of coins issued from the Mint, and to examine the questions connected with the loss in weight sustained by coins during their circulation. Before the invention of coined money, the precious metals circulated by weight. Examples of such currency are presented by the gold and silver "talents" of the Schliemann collection, which bear a definite relation to the Babylonian "mina;" and so completely has the spirit of this method of circulation by weight been retained, that the best definition we possess of coins, represents them as "ingots, of which the weight and fineness are certified by the integrity of the designs impressed upon the surfaces of the metal."*

Rice Vaughan, † whom I have before quoted, has some interesting remarks on this point in the section of his little work devoted to the consideration "of coining moneys without distinction of weights." He says the proposition is, "that there should be coined no pieces of a certain [*i.e.* definite] weight, either of gold or silver, but that, the allay being certain, the weight should remain uncertain; all money now current should be valued by a certain weight." For example, every ounce of silver should be valued at five shillings, and every ounce of gold at such a proportion as shall be thought most equal. He points out that, among other incidental advantages, this plan would prevent the "culling, washing, and clipping" of money, that is, its fraudulent reduction in weight; but on the other hand, the objection would be, as he says, "the extreme molestation which the people should receive in the practice of it, when every man should be bound to carry scales in his pocket,

and upon every little payment be bound to weigh their money." Few people at the present day bear in mind that this is precisely what, in the case of the gold coin, the existing law requires them to do, for the Coinage Act of 1870, now in force, directs, in Section 7, that "where any gold coin of the realm is below the current weight provided by this Act, every person shall, by himself or others, cut, break, or deface such coin tendered to him in payment, and the person tendering the same shall bear the loss." Compliance with this demand would, of course, render it necessary for each individual, who has reason to expect the tender of a sovereign, to carry scales and weights, as well as shears to cut such pieces as should be found to be deficient in weight.

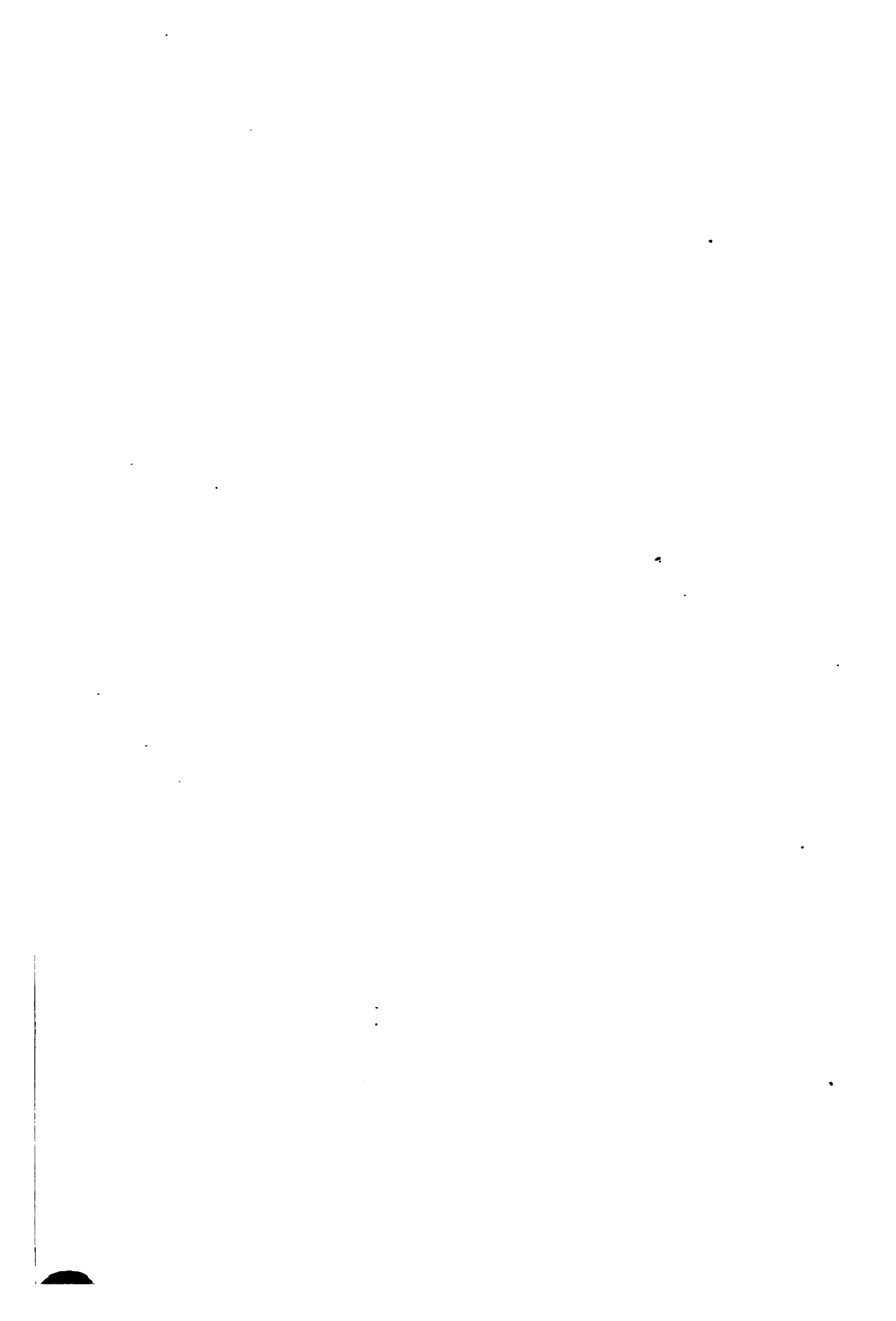
It will be well for us to examine—1st, what degree of accuracy as to weight the law requires in pieces issued by the Mint; and 2nd, how long gold coins may be expected to circulate without incurring the "extreme penalty of the law," which takes the same view of coins as is expressed in Butler's "Erewhon" with regard to humanity, and considers defective organisation and decrepitude in a coin to be criminal, and punishable by "cutting and defacing." Mr. John Biddulph Martin, whom I shall again have occasion to quote, well observes, "We are wont to speak of the life of a coin, but whereas the term 'life' is in all other cases associated with a period of growth, of maturity, and of decay, in this instance the process is one of degradation only."

The first schedule of the Coinage Act of 1870 prescribes the weight at which each coin shall be issued; it also defines the lowest weight at which the gold coins may be permitted to circulate, and it sets forth the "remedy" of weight—that is, the range above or below the exact standard within

* Stanley Jevons, "Money," p. 57. 1876.

† "A Discourse of Coin and Coinage," p. 214. 1675.





which the issue of coins would be legal. The silver and bronze coins, being merely tokens, have no "least current weight," but are withdrawn from circulation, and re-coined, when they become defaced by wear. The standard weight of a sovereign is 123·27447 grains, the remedy is $\pm 0\cdot2$ of a grain, and the least current weight, 122·5 grains. In the case of the half-sovereign, the standard weight is 61·63723 grains, the "remedy," $\pm 0\cdot1$, and the least current weight, 61·125 grains. In order to ensure that the coins issued from the Mint shall be well within the remedy allowed by law, it is necessary to adopt in practice a still more minute margin, or allowance for unavoidable error. The "working remedy" adopted in the Mint in the case of the sovereign, is therefore fixed at $0\cdot17$ of a grain, instead of the $0\cdot20$ which the law allows, and the weight which denotes whether a sovereign is or is not within the remedy, is represented by a piece of wire of fine gold, $0\cdot1355$ of an inch in length, and $0\cdot018$ of an inch in diameter, and weighing $0\cdot17$ of a grain. It will be obvious that the possibility of restricting the weight of coin within such narrow limits, entirely depends on the degree of accuracy which may be attained by the process of rolling the strips of metal from which the discs destined to form the finished coin, are cut; and we have already seen, in the first lecture, that in the case of the fillet prepared for the manufacture of the half-sovereign, a variation of $\frac{1}{10000}$ th of an inch above or below the accurate thickness, or a range of $\frac{1}{10000}$ th of an inch in the thickness of the fillet would cause the rejection of the coin, on the ground of excess or deficiency of weight. The question then arises—Is it not possible to supplement the operation of rolling by some mechanical operation, conducted on the blanks themselves, in order to bring them within a closer approximation to the exact weight. The problem has long proved an attractive one in Mints, but the earliest suggestion I can find for securing absolute accuracy in weight, occurs in the "Records of the Scotch Mint,"* from which it appears that J. Acheson claimed, in 1597, to have discovered a method of making coins so that none shall be "ane grane heavier or lighter nor another."

On the Continent it is very generally the practice to adjust blanks by the aid of a file, the weighing being performed by hand; the process is, however, open to the objection that

the marks of the file are never quite obliterated when the blanks are struck into coin, and the same objection applies to most of the machines that remove a fine shaving of metal from the surface of the blank. An additional objection to such a mechanical adjustment of blanks arises from the tendency, in Mints where it is adopted, to produce "too heavy" blanks in the rolling and cutting departments, as it is impossible to adjust blanks which are too light. Some years ago, Mr. J. M. Napier* devised for the Indian Mints an automatic machine of great beauty, which first ascertains how much it is necessary to cut from each blank in order to reduce it to the standard weight, and then removes the necessary amount of metal and no more. The initial cost of such machinery is, however, considerable. Another machine, having the same object in view, has been devised by M. Seyss.†

Chemical aid has not been wanting in the attempt to solve the question of the adjustment of blanks. In 1849, M. Diereck, Director of the Mint in Paris, endeavoured to substitute a chemical for a mechanical treatment, by submitting the heavy gold blanks to *aqua regia*, which, it was anticipated, would bring them within the prescribed limits of accuracy, by dissolving away metal. The results were not satisfactory, and the attempt was abandoned.

Having myself attacked the question in 1870, I may, perhaps, be permitted to refer to the results which attended my experiments. It was found that gold, alloyed with copper, might be removed from heavy blanks with singular regularity by means of a suitable solvent, aided by a battery. The blanks were arranged in a frame of wood, and submitted to the action of a solution of cyanide of potassium, the heavy blanks forming the dissolving pole of the battery. The process was not used in the London Mint, as it became evident that it could not replace the present system, under which finished coins alone are weighed, and the manufacture of good coin only is paid for. The late M. de Jacobi, one of the earliest workers in the field of electro-metallurgy, visited my laboratory while the first experiments were in progress, and we discussed the possibility of re-depositing the metal removed from the heavy blanks on those that were too light, the problem being to obtain a tenacious film.

* Patent, No. 108. 1866.

* "Records of the Coinage of Scotland," by R. W. Cochran-Patrick, Esq., M.P. 1876. Introduction, p. clx.

† "Dingler's Polytechnisches Journal," cxlv. 51; plate 5. 1882.

I was greatly interested to find, long after my experiments were made, that an eminent firm of electrotypers had suggested officially that the worn gold coins in circulation could be restored to the legal weight by the electric deposition of a film of gold on the surfaces. The process was, introduced into the Bombay Mint, in 1873, by the late Mr. L. G. Hines, who transferred the metal dissolved from the heavy blanks to blanks which are too light, the latter being by this means raised to the prescribed weight. Its importance in mints where its use is possible may be gathered from the fact that, in the Indian mints, no less than 1,300 tons of silver were converted into coin in one year (1879), so that the saving effected by its use must be considerable.

Whether or not a method for adjusting the blanks be adopted, the finished coin must be weighed before it leaves the Mint, and this, as before stated, is the great obstacle to the introduction of the electro-chemical method into the English Mint. In former times the weighing was effected only in bulk, but more recently, individual pieces have been weighed in this country. I have already pointed out that the weighing may be effected by hand, and this method is very generally adopted on the Continent and in America, where each operator is provided with a delicate pair of scales.

In the Mint of this country, very beautiful automatic machines are used, for a full description of which reference may be made to the "Encyclopædia Britannica."* [NOTE.—The general nature of the appliance was made clear by the aid of a model.] The balance was originally devised in 1851 by the late Mr. William Cotton, of the Bank of England, and has since been improved by the officers of the Mint, and by Mr. J. M. Napier, who has secured several patents in connection with this machine.

In the Vienna Mint, a balance devised by Herr Seyss is employed, which depends upon a somewhat different principle. The beam resembles that of an ordinary balance, with pans suspended from it; one pan contains the weight, and a slide brings forward the coin to the other pan; the depression of the beam produced by a heavy coin brings the balance pan opposite one of several slits, the lowest slit corresponding with the extreme depression of the beam produced by a very heavy coin. The pan is them momentarily

fixed, and the coin is allowed to pass away into the slit against which it stands. If the coin is very light, the pan which contains it will rise and stand opposite the highest of the series of slits.

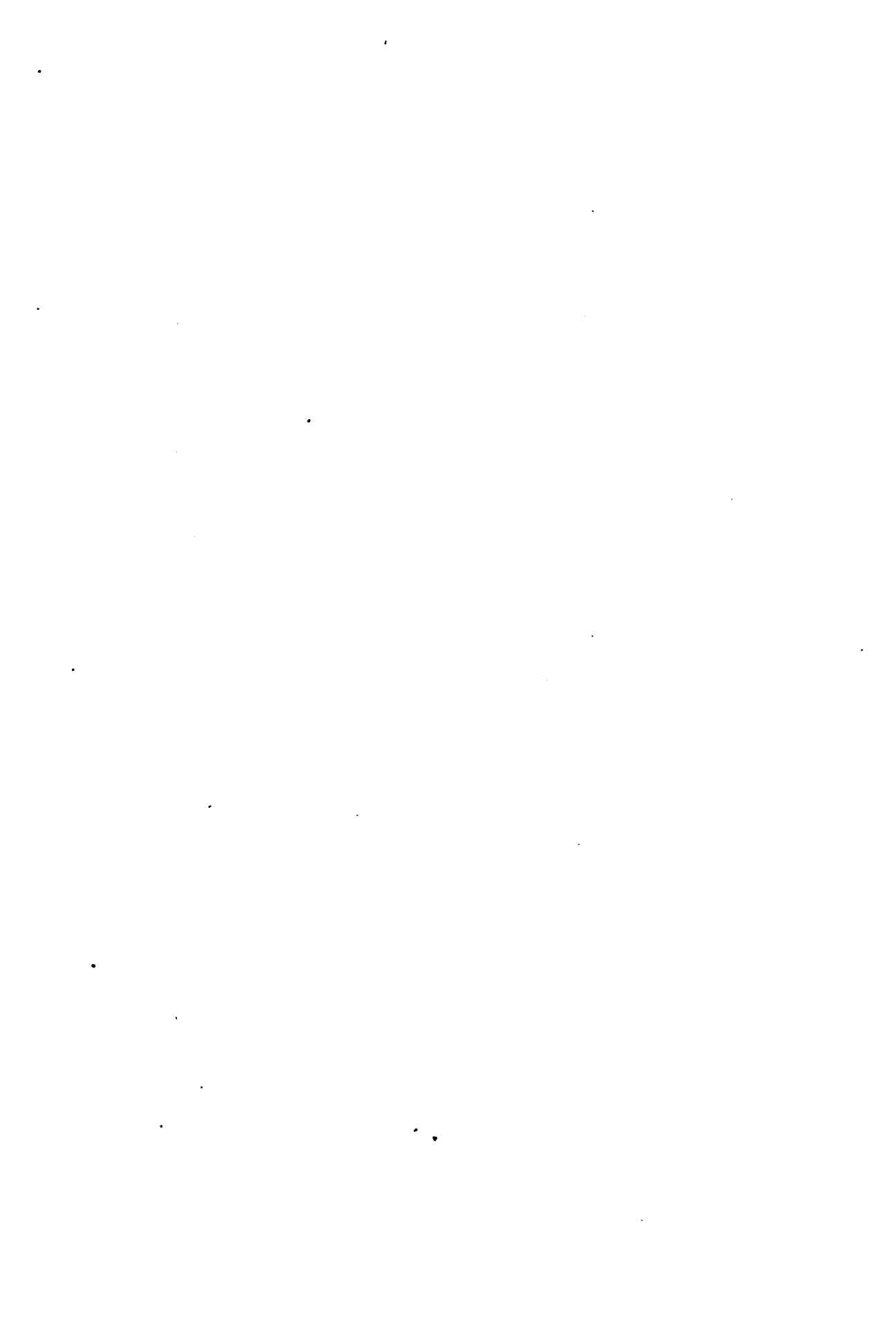
The life of a coin, after it leaves the Mint, may now be traced, and it will be seen that the conditions of its existence are far less severe in modern than they were in ancient times. The actual wear to which coins are subjected may, no doubt, be rougher at the present day than in the past; but, on the other hand, they are not subject, to anything like the same extent, to ill-treatment from enemies in the shape of clippers and sweaters.

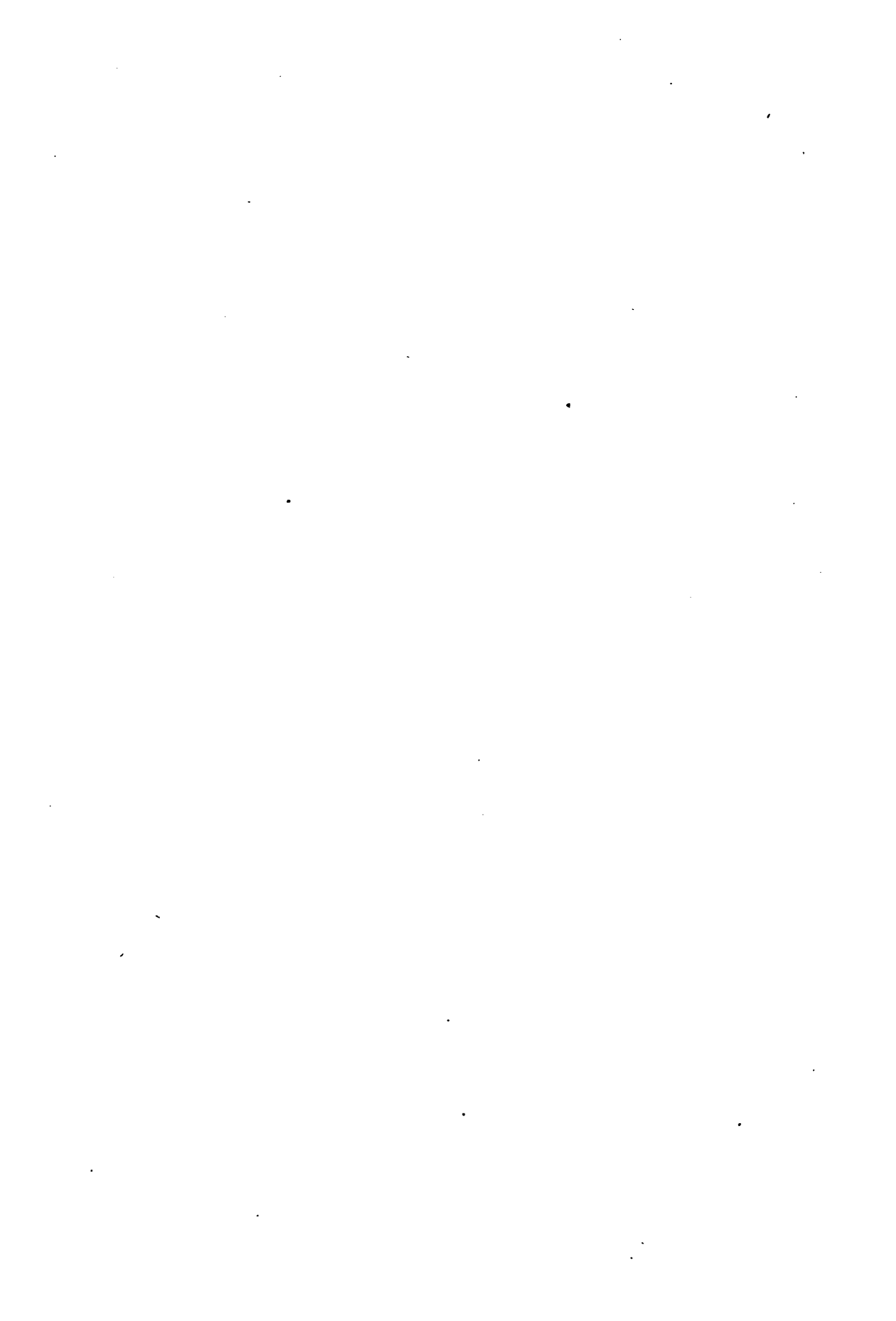
It is difficult to overrate the importance of some system of protecting the edge of the coin against fraudulent treatment, and it is hardly less difficult to understand, at the present day, the extent to which the ill-shapen hammered coins were tampered with. The earliest protection seem to have been afforded by a circle or beaded ring on the surfaces of the coin, and that such circles have been used from early times, is proved by the fact that many Greek coins bear them. Attention is specially directed to the outer circle in an enactment of King Henry VII., which provides that "every piece is to have a circle about the utter part thereof, and also that all manner of gold hereafter to be coined shall have the whole sculpture without lacking any part thereof, to the intent that the King's subjects might have perfect knowledge, by that circle or sculpture, when the coins were clipped or not." No protection, however, is as efficient as the addition of letterings or devices round the edge of the coins. I have already stated in the first lecture that the practice of marking the edges was adopted, for another reason, in Roman times in the case of the *Nummi Serrati*, mentioned by Tacitus.

Coins may be fraudulently reduced in weight by the action of a solvent aided by a battery, but there is reason to believe that the practice is only carried on to a very limited extent.

Removal of metal by drilling holes and filling them up by base metal has sometimes been resorted to, and the Mint Museum contains interesting examples of American coins which have been sawn so as to leave two thin flat discs, which have subsequently been soldered over a disc of base metal, the precious inside of the coin having been removed. It has been proposed to make the American gold double-eagle dish-shaped, in order to render the

* Ninth edition, art. "Mint."





centre so thin as to prevent this method of falsification. In mediæval times, tampering with the coin caused the gravest anxiety, and was punished with dreadful severity.

In 1381, the first equivalent of the modern Royal Commission on the Coinage met, and the following was the evidence, or rather were the recommendations, of the individuals who took part in it. Richard Leyc advised that the practice of clipping the gold coin could only be checked by a proclamation directing individuals to weigh coins when they took them, and Richard Aylesbury, a goldsmith, also held that gold pieces which had been reduced by clipping should be universally weighed by those who received them.* I will take only a few more historical instances of instructions as to weighing the coins tendered to individuals. The Mint Records† contain a copy of a proclamation given in the 17th year of King James I., which states that the people, instead of refusing such light gold moneys as were without the remedies * * * * do now for the most part accept in payments, indifferently and promiscuously, all such coins whatsoever tendered unto them, without weighing," which shows that the practice of weighing the coin had been adopted, and was falling into disuse. In 1619, the person who tendered the gold coin was instructed to give twopence for every grain the coin was light, and individuals were directed to brand every piece abnormally light by striking a hole through it, returning such pieces to the owners thereof, thus reaffirming a proclamation made in 1587 by Queen Elizabeth, which directed that the defective coins should be "stricken through and cut into pieces." In 1632, it is stated that "in and about London and Westminster, people carried scales in their pockets, to weigh gold on all occasions."‡ I mention these facts to show that the directions of the present law (Coinage Act, 1870) as to the cutting and defacing of worn coin, rest on ancient precept.

The condition of the silver currency in the end of the 17th century may be gathered from the statement of Lowndes, who computed the amount of all the silver moneys coined in the reigns of Queen Elizabeth, James I., and Charles I., at £15,109,476. Writing in 1695, and allowing for the sums coined in the reign of Charles II., James II., and William and Mary, he did not consider that the silver circulation consisted of more than £5,600,000, of

which only £1,600,000 was heavy;* and he further pointed out, as the result of careful weighing of the coin in bulk, that the weight of "the moneys commonly currant are diminished near one half." Not, it must be remembered, merely by legitimate wear, but by the fraudulent practice of "clipping," from which, I believe, modern coinages suffer to a hardly appreciable extent.

It is now necessary to consider the conditions affecting the circulation of a metallic currency, more especially as regards its power of resisting legitimate wear. An experimental inquiry conducted by the officers of the Mint towards the close of the last century, showed that $78\frac{1}{10}$ of the shillings then in circulation were required to make a pound weight, which should have been represented by 62 shillings; eleven years later, $82\frac{1}{10}$ shillings weighed a pound. With regard to the gold coinage, the Mint officers found, in 1807, that 1,000 guineas withdrawn from circulation, had lost 19s. per cent. in value. Parcels of 300 sovereigns, coined in each of the years 1817-21-25-29, were weighed by the officers of the Mint in 1853, and the results proved that they had sustained an average rate of wear of 0.047 grains per annum.

The rate of wear, in the case of gold coins, is dealt with by Jacob;† but we owe an authoritative determination of the annual rate of wear of the gold coin to the late Professor W. Stanley Jevons, F.R.S.‡—formerly assayer of the Sydney branch of the Royal Mint, and subsequently Professor of Political Economy at University College, London—who brought to the consideration of the question an acute intellect and perfect knowledge of the conditions which govern the metallic currency. He proved, as the result of an exhaustive inquiry, that "just about eighteen years' wear will reduce a sovereign below its point of legal currency;" and he shows conclusively that the average rate of wear per annum of the sovereign is 0.043 grains, which led to the conclusion that, at the time he wrote, 1868, "31.5 per cent. of the whole of the sovereigns in the kingdom are now no longer of legal currency." He estimated the annual average wear of the half-sovereign at 0.069 grains. Mr. Martin § has since repeated and extended Professor Jevons's inquiry. He has greatly added to

* "Essay for Amendment of the Silver Coins," p. 105. 1695.

† "The Precious Metals," vol. ii., p. 168. 1831.

‡ *Journal of the Statistical Society.* 1868.

§ *Journal of the Institute of Bankers,* June, 1882.

* Ruding, vol. i., p. 240.

† Record Book, vol. i., p. 56.

‡ Ruding, vol. i., p. 386

the value of the work by bringing it down to the present time; and his researches, which deal with no less than 105,364 sovereigns, confirm, in a remarkable manner, the average rate of wear deduced by Professor Jevons, who adopted a different method of calculation. It may safely be assumed, therefore, that any sovereign which has been in circulation more than eighteen years has been reduced to a point at which it is not legally current, and should, therefore, be withdrawn from circulation, in order that it may be re-coined.

The questions now present themselves—Can this average rate of wear be diminished? Is the form of the coin well adapted to enable it to resist wear; and is it possible to adopt a more durable alloy for our gold coinage? First, with regard to the form; no doubt a sphere which contains the maximum weight in the smallest surface is better adapted than a disc to resist the abrading influence of friction, and it follows, therefore, that the Siamese money, which is nearly globular, will retain its weight longer than any other coin now in circulation.

A short cylinder is the geometrical form which, next to the sphere, presents the smallest surface for the greatest weight, and, consequently, in order to reduce the wear of coins to a minimum, their thickness should be equal to their diameter. Such a form would present many inconveniences; but, on the other hand, coins should not be made too thin, and much may be gained by even a small approach to theoretical requirements. A good practical rule for calculating the most useful diameter of a coin from its weight is given by the following formulæ:—

$$D = P \sqrt[3]{G}$$

D = Diameter in millimetres.

G = Weight in grammes.

P = A certain number found by experiment.

Take the cube root of the weight of the coin, multiply by the number for the particular coin, and this gives the most suitable diameter in millimetres. The value of P for all kinds of gold coins is 11.3.

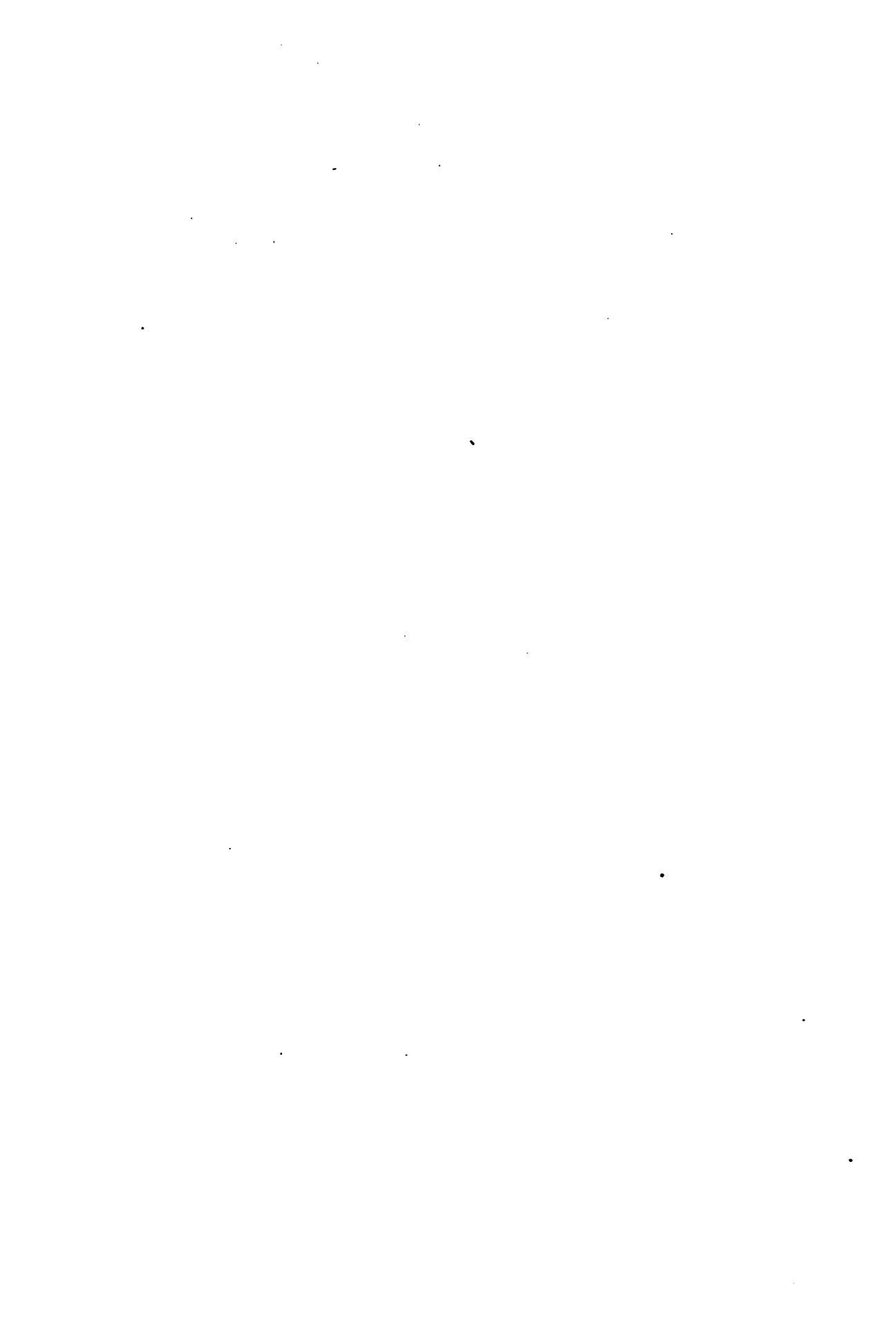
I have thought it advisable to make the above reference to the matter, although it is not likely that the form of our coins will ever be greatly modified. The mean thickness of the coin does not differ much from the initial thickness of the blank, because in virtue of the

“flow” of metals, to which allusion has already been made, the portions of metal diminished in thickness are about balanced by the raised part of the device. Sharp new coins do not wear much more rapidly than old ones, as is shown by the experiments of Professor Jevons and Mr. Martin, that is, the rate of wear of coins at different periods of their career is fairly normal. There is no doubt that a coin in high relief becomes disfigured much sooner than one in low relief, as the unity of a design is greatly impaired by the loss of a prominent feature, and the lovely Renaissance works in low relief [now before you] present a much better appearance after prolonged circulation than their classical predecessors, which are almost lenticular in form. The power of the metal to resist, not wear, but deformation by impact, therefore demands attention, and from this point of view a soft metal is far less useful than a hard one. Coins of lead, for instance, have been found, in experiments to which reference will be made presently, to become rapidly defaced, and reduced to the state of mere blanks, when submitted to mutual action in a revolving drum. Coins of pure gold also become rapidly defaced, although their weight is but little reduced by such treatment. As has already been pointed out, the reason for using an alloy instead of pure metal is the greater durability of the former, and accurate experiments on this point have not been wanting. Their history may be briefly stated as follows:—In 1792, the unfortunate French Statesman Clavière* proposed that pure metals should be used for coinage, and that they should be current by weight. The Académie des Sciences was consulted on the subject, and experiments made by this distinguished body† showed that while the pure metals were rapidly reduced in weight by friction, the addition of even a small amount of base metal had a notable effect in enabling the metals to resist abrasion by wear. In 1798, the Privy Council appointed a committee “to take into consideration the state of the coins of this realm,” and they directed Mr. Henry Cavendish, F.R.S., and Mr. Charles Hatchett, to ascertain experimentally whether the loss of gold coins by wear was “occasioned by any defect, either in the quality of the standard gold, or the figure or impression of the coins.” The result was an elaborate investigation,

* Karmarsch, “Handbuch der Mechanischen Technologie,” vol. i., p. 551. Hanover: 1876.

* “Traité des Monnaies,” par. P. F. Bonneville. p. xxiii. 1806.

† “Annales de Chimie” (1793), tome xvi., p. 230.





conducted by Mr. Hatchett,* on the "comparative wear of gold," the results of which have since been frequently quoted, and have, in fact, become classical. Hatchett operated both on unstamped blanks and on discs struck by dies, which produced small "rounded prominences, regularly disposed over the surface of the coin." Such blanks, or coined discs, were arranged in two frames, so that the flat surfaces of the metal could rub against each other when the frames were pressed together. Each frame was moved rapidly backwards and forwards by suitable mechanism, the path of each frame being at right angles to the other. The discs were in this way subjected to mutual friction, and the gearing was so devised that while one frame was moving with its greatest velocity, the other was at the extremity of its path, the result being that the coins were prevented from moving always in the same line. The numbers of "revolutions" or contacts of the pieces varied from 20,680 to 229,000. He also used a cubical box of eight inches, in the side, in which the coins were made to revolve; and the discs were also rubbed on a table covered with either flour, fine chalk, or metallic filings, fixed in isinglass. Hatchett's main conclusion was that the "extraordinary loss which the gold coin of the kingdom is stated to have sustained within a certain limited time, cannot, with even a shadow of probability, be attributed to any important defect in the composition or quality of the standard gold."† He further observes "that the experiments on the various alloys of standard gold (that is gold standardised with various metals) concur with established practice and opinion to prove that only two of the metals, viz., silver and copper, are proper to be employed in the reduction of fine gold to standard for the purpose of coin." Notwithstanding the care and skill employed by Hatchett in conducting his experiments, some of his deductions appear to demand confirmation. The subject possesses additional interest at the present time, because it is probable that much of the light gold coin now in circulation will soon be withdrawn; and it has therefore been considered advisable that Mr. R. A. Hill, Superintendent of the Operative Department, and myself should resume an investigation on the relative wear of coins of different metals and alloys, which was begun by one of us during the Mastership of the late Mr. Graham. After several preliminary experiments, in which

a sliding motion was given to pieces of metal along a smooth surface of oak, we satisfied ourselves that revolving the pieces in a box represents more faithfully the kind of friction to which coins are subjected in the varying conditions of their circulation, and this view was fortified by the opinion of the late Professor Jevons. We addressed ourselves mainly to ascertaining whether the alloy used for the British gold coin, the standard of which is 916.6 is, or is not, more durable than the alloy of 900 fine, which is so widely used by other nations; and we are satisfied that the experimental evidence proves, as regards rate of wear, that there is not much to choose between standards 916.6 and 900. On the other hand, differences in mechanical treatment, resulting from a heavy as compared with a light blow, or in thermal changes produced by annealing, exert greater influence on the rate of wear than the small variation in composition comprised between the limits 900 and 916.6. We agree with the view taken by M. Feer-Herzog* that differences of wear of coins of these two alloys is very slight.

Our experiments are in progress, but the results hitherto obtained are published in the Mint Report for last year.†

The use of aluminium has often been suggested for the manufacture of subsidiary coins, this metal being known to possess the great tenacity when equal volumes of it and other metals are compared. We have been much interested to observe that coins of aluminium, especially if they be alloyed with about 2 per cent. of nickel, are very durable, as are also coins of pure nickel; but in one case the durability results from toughness, and in the other from hardness.

There is one other point in connection with the gold currency to which I would now direct your attention. The Coinage Act of 1870 fixes the remedy on each individual piece, and not, as was the case formerly, on the pound weight of the coin. The object of this provision is to prevent the "culling" the heavy pieces, which would be a profitable transaction if the inequalities of weight were considerable. The heavy pieces so selected might either be exported or used in the arts, and the annals of the coinage abundantly indicate the extent to which the practice was carried on in former times. A notable case occurred in 1637,‡ when

* See "Enquête sur la question Monétaire" (Paris, 1792), vol. i., p. 344.

† Fourteenth Report of the Mint, p. 45, 1883.

‡ Ruding, vol. i., p. 389.

* Phil. Trans. Roy. Soc., 1803, p. 43.

† Loc. cit. p. 190.

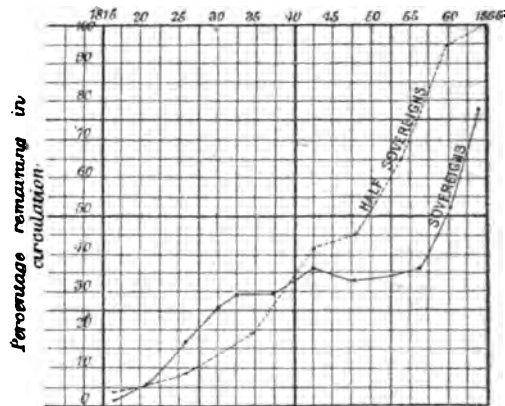
the Attorney-General charged several persons before the Star Chamber with "culling out the weightiest coins, and with melting down his Majesty's moneys into bullion;" and, on examination, it appeared "that between the years 1626-1631, one Timothy Eman culled £500,000 a-year, which yielded £7,000 or £8,000 of heavy moneys yearly, and in five years he melted down £15,000, his profit therout amounting to £100." Another offender was Violet, whose name deserves mention, as his work "An Appeal to Cæsar" contains so much curious information as to the export of bullion.*

I regret to say that the practice of culling is not absolutely unknown at the present day. Professor Jevons stated in 1868, that he "received overwhelming evidence that this picking and culling of the coinage, as it used to be called, is practised as an ordinary business transaction by all banks which need to make remittances to the Bank of England," in order, that is, to avoid the loss which would be entailed if light coin were sent to the Bank, where it would be cut and the deficiency charged for. "It will thus be apparent," Professor Jevons adds, "that there exists a regular system, whereby the older coins are continually returned into the hands of the public, and the new heavy coins alone are returned to the Bank of England, or to those who would melt or export them."

The amount of gold actually in circulation is estimated to be £100,000,000, but the coinage returns show that the amount of sovereigns and half-sovereigns issued since 1816, when their coinage was begun, is £247,521,429. What, then, has become of the 147 millions not in circulation? The coinage returns show that between the years 1864-83, £57,492,842 in sovereigns were coined. A considerable proportion of these have been exported never to return. The following figures, which I offer with some hesitation as they may not be rigidly accurate, show that, while during the same period sovereigns were exported and imported, the excess of exports over imports was no less than £25,991,445, or a yearly average of £1,299,572.

With regard to the disappearance of gold coins from circulation, Professor Jevons has some observations of extraordinary interest. He says it appears "that of the sovereigns coined in 1817-19, not more than one-fiftieth part remain in circulation; and the

proportion rises until, between the years 1840-1858, it is about one-third." He suggests in his paper that these curves should be plotted graphically, and this I have done.*



In both cases there is an elevation in the period 1840-45, arising probably from the re-coinage of the years 1841-43, when £14,000,000 of gold coin were called in and redistributed in an unusual manner, so that more than a common proportion became fixed in the circulation. The most important peculiarity of the numbers is the very small increase which takes place in the proportion of sovereigns preserved between the years 1832 and 1854; this indicates that there is a residuum of coin which is no longer subject to be exported or withdrawn, like the rest of the circulation; for if the proportions of coins exported were taken indifferently, the curve would rise as rapidly as is the case with the half-sovereign curve, those coins not being liable to exportation.

It will be evident, therefore, that in tracing the analogy between the life of a coin and ordinary vital phenomena, we are abruptly checked by observing that the "fittest" coins are not those which survive as the fittest; that is, the heavy ones drop out of the struggle of active circulation they were created to sustain, and are either exported, or exist as part of a "hoard" of coin. It may, of course, be urged on this ground, that a full-weight coin, issued to the public without charge, is not the fittest to retain its place in circulation, and that a small amount of metal lost by wear really tends to its preservation.

With that Darwinian problem, I must bring

* "An Appeal to Cæsar," by Thomas Violet, of London. 1660.

* Since the above was written, the late Professor Jevons' "Investigations in Currency and Finance" has been published, and this valuable work also gives similar curves.





these lectures to a close.* You have seen the great change and depreciations through which the "alloys used for coinage" have passed in times gone by, but there is no probability that in this country similar changes will take place in the future, and I cannot find better words to offer you than a quotation from Professor Jevons, whose perfect grasp of the question of metallic currency enabled him to realise its difficulties in a way few of us are able to do. He points out that, in times past, the rulers of nations have been the most notorious false coiners and depreciators of the currency; but that now "the danger lies quite in the opposite direction—that popular govern-

* Since the above was written, I find that Mr. J. B. Martin incidentally pointed to this analogy in a paper read before the Institute of Bankers in March last.

ments will not venture upon the most obvious and necessary improvement of the monetary system without obtaining a concurrence of popular opinion in its favour; while the people, influenced by habit, and with little knowledge of the subject, will never be able to agree upon the best scheme."

I can say with Rice Vaughan that "my scope was not to render the reader able to find out the fittest course to govern this matter of money and coin, but able to judge of what should be propounded by others;" but we need no longer fear the state of things described by him when he says "that for want of that ability the wisest states and the greatest Councils of Christendom, for many ages, have been abused by mysterious names and perplexed subtleties of Mint-men."

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GREAT SALE OF ENGLISH COINS.

Messrs. Sotheby, Wilkinson, and Hodge concluded on Saturday, at their rooms, Wellington-street, Strand, the sale of the remarkable collection of Anglo-Saxon and English coins formed by the late Rev. Edward J. Shepherd. This sale is the most important of its kind since the dispersal of the Murchison Collection of Coins in 1864. Prices throughout were good, some being extraordinary. The most important lots were as follows:—Early British Coins: Gold Cuneobeline, rare, 6s. 2s. 6d.; Ethilberht (568-615) Sceatt, fine and of great rarity, 37l.; Boldred penny, 805, silver Canterbury Mint, bust to right, 40l.; another penny, without head, 18l.; Offa penny, bust in ornamental robe to right, 18l. 5s.; Cynethryth (Queen of Offa) penny, from the Pembroke Cabinet, 24l.; Ecgerht (son of Offa) Penny, 22l.; Coenwif penny, found near Wrotham, in Kent, well preserved, 12l. 10s.; Beornwulf penny, very rare, from the Murchison Cabinet, 20l. 10s.; another found at Dorking, Surrey, 17l. 10s.; Ceolwulf II., 874, penny, very fine, from the Cuerdale Find, 22l. 10s.; Beonna, 775, Sceatta, found near Ipswich, 20l. 10s.; Egfrith, 670, Styca, 20l. 10s.; Kadberht and Archbishop Ecgerht, Sceatta, with male figure, presumed to be the Archbishop, standing, and holding two crosses, 10l. 8s.; Regnald penny, only one other coin of this type known, 20l. 10s.; Archbishop Jaenberht's penny, a double cross, from the Murchison cabinet, 24l. 10s.; Archbishop Aethilheard's Penny, from the same cabinet, 21l. 10s.; Archbishop Vulfred's penny, 804., 16l.; another, with a monogram, 15l.; Archbishop Ceolnoth's penny, 10l. 10s.; Archbishop Ethared (under Alfred) penny, of great rarity but slightly cracked, 50l. 10s.; Ecgerht, 850, penny from the Bentham Collection, 25l.; another penny of the same monarch, unpublished, 22l.; Alfred penny, long bust to right, 19l.; Hadred halfpenny, found at Tewkesbury, 13l.; Radgar penny, crowned bust to right, rare, 30l. 10s. Post Conquest. — Gold Coins.—Henry III. Gold penny, a beautiful and very rare little gem, weighing 45 grains, from the Martin and Murchison Cabinets, 205l. (Webster); Richard II. noble, without flag, from the Cuff Collection, 15l. 5s.; Richard II. half noble, without flag, 27l. 10s.; Henry IV. noble (heavy), with flag, considered to be unique, 38l. 10s.; Henry IV. noble (light), 20l.; Henry IV., half noble (heavy), 50 guineas (Webster); quarter noble (heavy), 16l.; Richard III. angel, 14l.; Richard III. half-angel, 26l. 10s.; Henry VII. sovereign, 28l.; Henry VIII. sovereign, 18th year, 17l.; Henry VIII. sovereign, 34th year, 200 grains, finely preserved, 40l.; Henry VIII. George noble, 40l.; Henry VIII. half George noble, unique and unpublished, 255l. (Rollin). A Mr. Curt, who was present at the sale, bought this remarkable coin in Paris many years ago for 3s. 6d. Edward VI. sovereign, third year, 33l.; Edward VI. gold crown, sixth year, 12l. 15s.; Edward VI. gold half-crown of sixth year, rare and fine, 20l. 5s.; another gold half-crown, 22l.; Mary sovereign, 12l.; Mary rial, 1553, Queen standing in ship, 60l. 10s.; Mary angel, 13l. 5s.; Mary half-angel, 15l.; Elizabeth noble or rial, 15l. 10s.; Elizabeth milled gold half-crown from the Martin cabinet, 30l.;

James I. half-sovereign, 13l.; James I. gold half-crown, 13l. 5s.; thirty-shilling piece, 11l. 10s.; another, with trefoll, 15l.; noble or rial, 12l.; fifteen-shilling piece, 15l. 10s.; Charles I. sovereign, Tower Mint, 16l.; Oxford three-pound piece, 23l. 5s.; another, 20l.; Briot's Mint pattern sovereign, 29l.; Briot's half-sovereign, 20l. 10s.; Briot's gold crown, 62l. 10s.; Bristol sovereign, 1645, 36l.; Charles II. hammered coinage, broad piece by Simon, 14l. 5s.; Charles II. milled five-guinea piece, 10l. 15s.; James II. five-guinea piece, 1686, 19l. 5s.; William and Mary five-guinea piece, 1691, with elephant and castle under bust, 14l.; Anne five-guinea piece, 1705, 20l. 10s.; George I. five-guinea piece, 17l. 15s.; George II. five-guinea piece, 3l. 10s.; George III. five-guinea piece, pattern by Tanner, 44l.; another pattern, by Pistrucci, with St. George and the Dragon, 48l. 10s.; George IV. five-pound piece, by Wyon, 11l. 5s.; Victoria five-pound piece, with plain fillet ornamented diadem, 15l. Silver Coins.—Henry I. penny, 13l. 10s.; Henry, Bishop of Winchester, penny, profile bust of King Stephen (rare), 35l. 10s.; Henry IV. great, after 15th year, 28l.; Henry IV. half-groat, 21l. 10s.; Henry IV. half-groat, York, 10l. 15s.; Richard III. half-groat, 16l.; Henry VII. shilling, third coinage (rare), 30l.; Henry VIII. shilling, 32l.; Henry VIII. groat, struck at Tournay, the finest of the three specimens known, 20l. 10s.; Edward VI. crown, 27l. 10s.; half-crown, 17l. 5s.; penny, sovereign type, 6l. 15s.; shilling, base coinage, 11l. 5s.; another, of pure silver, 13l.; penny, 22l.; halfpenny, Bristol, 19l. 10s.; Mary penny, 10l. 15s.; Elizabeth crown, 14l. 5s.; shilling, 8l. 15s.; two milled sixpences, 3l. 15s.; a milled threepence, 3l. 4s.; a milled three-farthling piece, very rare, 21l. 10s.; James I. crown, first coinage, 11l. 10l.; half-crown, 42l.; shilling, 15l. 15s.; a sixpence, 17l. 15s.; Charles I. crown, 12l.; another, with rose, 14l. 15s.; half-crown, 27l. 10s.; shilling, 10l. 15s.; sixpence, 6l. 10s.; Exeter Mint crown, 10l. 5s.; half-crown, King on horseback, Declaration type, the finest known, 18l. 10s.; shilling and penny, 10l. 5s.; Oxford Mint, pound piece of fine work, 51l. 10s.; another a year earlier, 1643, 20l. 10s.; the celebrated Oxford crown by Rawlins, 1644, rare and in very fine condition, 110l. (Verity); Briot's Mint half-crown, 11l. 10s.; Aberystwith half-crown, 10l. 15s.; Aberystwith shilling, 15l. 5s.; Chester half-crown, 8l. 10s.; Worcester, half-crown, 10l.; Weymouth half-crown, 10l. 5s.; half-crown, barbarous imitation of the Aberystwith type, 11l. 10s. Sixe pieces—Carlisle three shillings piece, 16l. 10s.; Carlisle shilling, 10l.; Colchester pound piece, 13l. 5s.; Scarborough sixpence, square, 12l. 15s.; Commonwealth crown, 1653, 13l. 15s.; half-crown, 1656, 13l. 5s.; shilling, 1651, 9l. 15s.; sixpence, 1656, 9l. 8s.; half-crown, pattern by Ramage, 1651—a fine coin, very rare, from Lord Pomfret's Collection, 52l.; half-crown, pattern by Blondeau, 26l.; another, with edge inscribed "In the third year of freedom by God's blessing restored," 12l. 15s.; Cromwell crown, 14l. 14s.; Charles II. half-crown, by Simon, 11l. 5s.; milled crown, 1662, 20l.; pattern crown in pewter, by Simon, as brilliant as when struck, unique, from the Duke of Devonshire's Collection, 31l.; shilling, 1663, 11l. The sale, consisting of 534 lots, realized 5300l.



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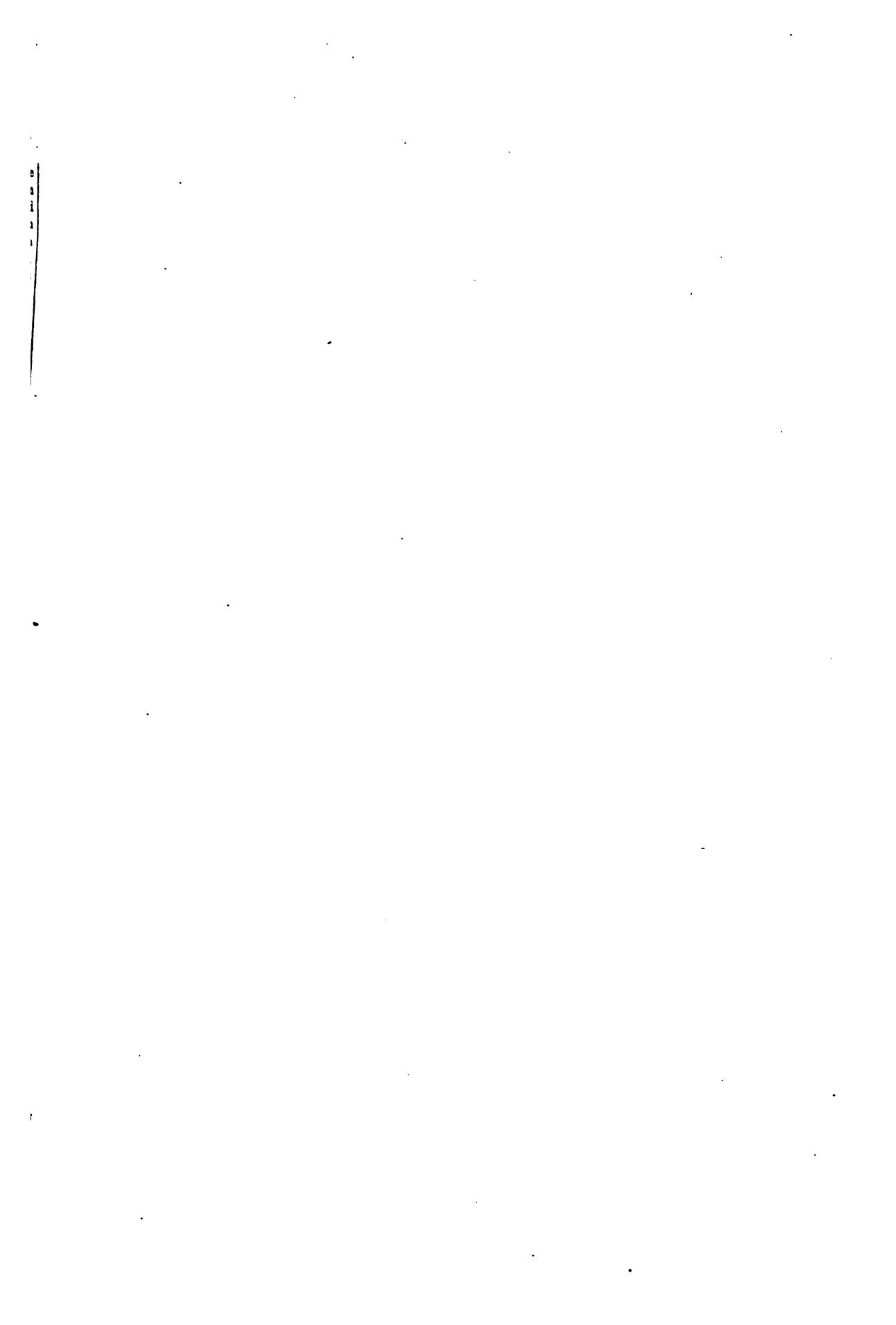
A coin, speaking generally, is one of the few articles of exchange which have an unvarying value. A Bolivian dollar or an Indian rupee, or a half-sovereign after very hard usage, may possibly deteriorate in value. But, save under exceptional circumstances, there is no getting more for a crown, or a mark, or a Napoleon, or a Gold Eagle than the sum inscribed on its face. Even the Mexican dollar has ceased to be held at a premium, and gold is still plentiful enough for the time to be far distant when, as used to be the case so far as guineas went, it will take thirty shillings to purchase a sovereign. But when the tyro in numismatics reads the prices which some old English coins brought at Messrs. SOHBBY'S on Saturday he may be pardoned if his ancient faith in the determinate worth of the currency is seriously shaken. We hear on every side of hard times and the depression of trade. Yet the merchant whose balance is on the wrong side of the ledger must experience a searching of heart when he is told that there are plenty of people ready to give forty pounds for a penny a thousand years old, thirty pounds for a half-crown of Queen ELIZABETH, and two hundred and fifty-five pounds for a half George noble of HENRY VIII., which one of the company present on Saturday had some years before bought for the sum of three and sixpence. A milled three-farthing piece brought over twenty guineas, and even a bad shilling of EDWARD VI., instead of getting the "utterer" or anybody else into trouble, was eagerly purchased for over eleven pounds sterling. It is clear, therefore, that, whatever may be the case in other branches of commerce, the traffic in this costly kind of goods is much brisker than the humble collector might desire. Of late the holders of pictures, enamels, pottery, and similar kinds of brittle ware have become rather alarmed over the diminished prices which such articles have brought in auction rooms. Not unnaturally, the scarcity of money among those who were a few years ago the rich people of England has been set down as the cause of this "shrinkage in value." No doubt, this is to a limited extent true. But when the collector can afford to gratify his taste in the expensive fashion shown on Saturday, the optimist is justified in clinging to his fancy. It must be consoling to him to note that twenty, thirty, and fifty pounds were eagerly bid for objects which are in themselves of only a modest intrinsic value, and which entail in their safe keeping an amount of anxiety that is dearly repaid by the pleasure of possession.

The practice of collecting rare coins has, in truth, never been without its enthusiastic followers, though at one time the enthusiasm of the student has been brisker or slacker than at another period. A cabinet of modern pieces has, from an historical or even an artistic point of view, no higher merit than an album of postage stamps. But a drawerful of early Greek drachmas, or of those quadrilateral pieces of copper, dating considerably later than the Roman Kings, and known as the *as signatum*, constitute the distinct materials from which history is written. An early British coin before the Roman invasion has only a vague antiquarian interest. No sooner, however, do we come to pieces with names on them—names in many instances which, but for these metal memorials, would have passed from the memory of man—than we feel that every slip of gold is a page of history. Even after the early British coinage ceased, the chronicler of the Roman Empire closely scans the pieces struck by CARAUSIUS, Emperor in Britain only, which bear the impress of the Mints at London and the town we know as Colchester. And so he goes on until, with the Imperial coins of MAGNUS MAXIMUS, he comes to the period when Britain had so far become an integral part of the waning Empire that it was not necessary any longer to regard it as deserving of a separate currency. A coin is valuable not merely for the story it tells, the portrait it affords of some Ruler, the hints it supplies regarding the religious rites of the people using it, or as a specimen of the medallary art of the period. It may also have that arbitrary value which is inherent in particular editions of old books, though, of course, the points for which it is esteemed are, to a certain extent, of historical importance. HENRY VIII., for example, struck two-sovereign pieces, and largely increased the number of sovereigns. At first he followed the type instituted by his father. But later on he instituted a second type, having the King seated on a throne on one side, and on the other the English shield supported by a lion and a griffin. He likewise struck rose nobles or ryals, angles and anglets, and when the ryal at six and eightpence had risen to be worth ten shillings, he issued the George nobles at the lesser value. It is a unique half-noble of this series which brought so high a price at Saturday's sale. Again, HENRY VII. was the first King subsequent to HENRY IV. who used a numeral on his coins, so that this fact renders them of a certain importance in the eyes of collectors. If the collector's purse is narrow, he may limit himself to the coinage of a particular dynasty, or even of a particular Monarch.

ELIZABETH gives him ample opportunity for indulging this taste, for that Queen issued no fewer than twenty different kinds of coin. Different Mints, on the other hand, have a special attraction for some collectors. CHARLES I., in the course of his wandering life, established numbers of Mints, and at the sale to which we refer specimens of some of these brought high prices. Altogether, there may be found in cabinets money bearing his name struck at Aberystwith, Bristol, Chester, Cork, Dublin, Edinburgh, Exeter, London, Oxford, Shrewsbury, Weymouth, Worcester, and York, and beside these "siege pieces" issued in towns or castles which were in a state of siege. A Carlisle three-shilling "siege piece" fetched over sixteen pounds, an Aberystwith shilling more than fifteen pounds, and a Scarborough square sixpence twelve pounds fifteen shillings, while had there been a Pontefract siege piece, struck actually after the death of CHARLES I., and bearing the legend "Carol. II. post Mortem Patris pro Filio," the bidding would have made glad the heart of the auctioneer.

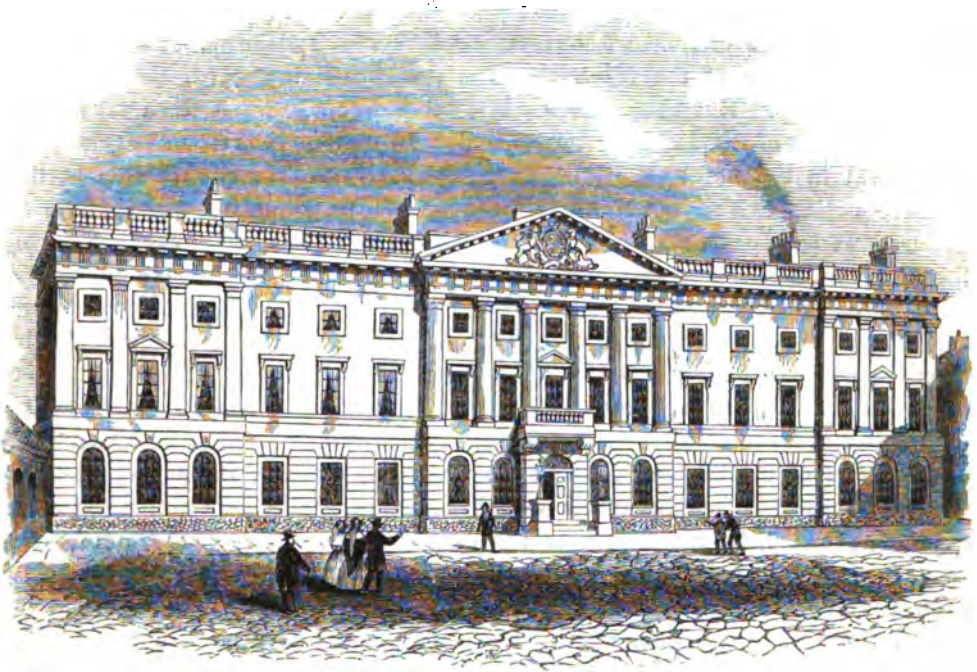
Coin collecting thus affords an inexhaustible supply of the material out of which history is extracted. It has all the pleasures of book and manuscript hunting without the numerous drawbacks which attach to those seductive methods of spending money and time. The book-worm and the tooth of time cannot injure the coin accumulator's treasures, and fire may, for all practical purposes, be regarded as just as little likely to damage them. It is possible that his cabinets may by some accident, or some fire, or some whim of fashion, decline in value. But at the worst there is always the metal to fall back on. It is, moreover, "portable property," and can be put into a place of safety when danger threatens. No doubt, this simple fact also constitutes one of its risks. For if portable to the owner, it is portable also for the thief. Rival collectors are dreaded, and faithless Curators like RODOLPH RASPE, who wrote "Baron Munchausen," and fled from Germany after making free with the Landgrave of Hesse-Cassel's coins, are to be shunned. When the French virtuoso was hard pressed by a Salée Rover he swallowed a collection of medals, and Baron STOSCH, after being detected purloining the contents of the Royal Cabinet, had an emetic administered to him. A coin is always a coin, so far as "face value" is concerned. But as a valuable relic it is sometimes a very precarious investment. A three-farthing piece may be well worth twelve pounds to-day, but if to-morrow a buried jar of three-farthing pieces is dug up, or if even

half a dozen fresh examples are discovered, the first specimen will immediately lose its value in the coin market. This is the one great fear and hope of the collector. He never knows when there is to be a fresh find. In the days when public confidence in banks was very limited, people were in the habit of burying their surplus wealth. The security was considerable, though there was no interest. The worst feature of this method of storing wealth was that the owners had a habit of dying without telling where they had buried it, and sometimes, indeed, they lived without being able to find it again. These hidden hoards are being constantly turned up by the plough, to the delight of students in whose drawers there are blanks, and the dismay of the unfortunates with "unique specimens." There are, however, still hunting-grounds where the keen collector may run down choice game. In the Bazaar of Fex, a coin of the Moorish Kings of Grenada has been given in change, and the whole of Morocco is one vast graveyard of ancient money pots which the steam plough of the future may bring to the surface. Hence, though the forger and the electrotyper have made life a burden to the numismatist, there is no saying what pleasures are still in store for the man who has hitherto been content with rose nobles, and groats, tokens, and bonnet pieces.









[The Mint.]

LIII.—THE MINT.

A STRIKING illustration of the magnitude of the transactions of the British Empire may be drawn from the recent records of the Mint. Between the years 1816 and 1836 the money coined in it amounted in round numbers to a quarter of a million of copper, twelve millions of silver, and considerably above fifty-five millions of gold, making a total of between sixty-seven and sixty-eight millions of money sent into circulation within twenty years. Whilst we are dealing with figures, we may add that the charge for coining this enormous amount of precious metal was nearly four hundred and twenty-one thousand pounds, and the actual cost about two hundred and fourteen thousand pounds, leaving a profit to the Company of Moneyers not much less in amount. Any one may send bullion to be coined, but for many years the Bank of England alone has been the medium between the foreign importer and the Mint. During the lapse of time the sources of our supplies of bullion have been frequently changed. Time was when even England itself added silver to the other inexhaustible stores which it was for ever pouring forth from its bosom; Edward I., for instance, received no

less than seven hundred and four pounds *weight* of silver during the year 1296 from Devonshire, and down to the reign of George I. silver money has been coined from the proceeds of the Welsh and other native mines. The principal sources of supply at present are the mines of Peru and Mexico for both silver and gold; and from the mines comparatively recently discovered in the Russian Ural mountains a large quantity of gold is also received. The Bank buys silver at the market price, which fluctuates; gold at 3*l.* 17*s.* 9*d.* per ounce; but it will make no purchases of gold without having first sent specimens for assay to the king's assay-master of the Mint. This is the simple history of our uncoined money generally. But there are some notable exceptions. A few weeks since the newspapers of the day informed us that considerable interest was excited by the arrival in the Borough of the first portion of the ransom payable by the Chinese nation to the British Government, which amounted to two millions of dollars. It was packed in wooden chests, and filled ten waggons and carts, forming a train of considerable length; and was escorted by a detachment of the 32nd regiment. The whole passed over London Bridge, and was conveyed to the Bank. This money, which weighs upwards of sixty-five tons, was brought from China by Her Majesty's ship 'Conway.' It will, no doubt, ultimately be coined into British money, and we shall be circulating our shillings and six-pences to and fro without the slightest notion of their having once formed a part of the price of Canton—nay, for aught we know, some of them may in their state of transformation find their way back again to the Celestial Empire, to gladden, possibly, for a second time the eyes of some unconscious Chinese, and be treasured for their novelty in the same cabinet where they had previously been hoarded for their intrinsic value. In 1804 a somewhat similar convoy passed through the streets, which had been taken under no less memorable circumstances. Political considerations having determined our Government to commence war with Spain, a bright notion occurred to it before making a formal declaration of its purposes. Some Spanish vessels with treasure were then expected home; accordingly Captain Moore, with four vessels, was despatched to intercept them. He was successful, but did not obtain possession of the prize till the Spanish admiral's vessel had blown up, and some hundreds of persons had gone to their last account. To the honour of the British people, their indignation was all but universal. There was one incident that did much to deepen the general impression of the affair. A Spanish gentleman was on board one of the ships, who, after twenty-five years' industry and economy in America, had realised a fortune, and was now returning to his native country, contented in its possession, and blessed with a numerous and beautiful family to share it. Before the action commenced, he, with one of his sons, went on board one of the largest ships, the better perhaps to assist in repelling so unexpected an attack; and in a few minutes beheld the one in which he had left his wife and his other children surrounded with flames. This was the admiral's ship already mentioned.

None of the humiliating and painful reflections attached to this case belonged to the one preceding it by some forty years, and which accordingly seems to have been marked by a very joyous sort of procession. The day was a remarkable one, being that on which the young sovereign George the Third's first son and successor was born. "Just after Her Majesty was safely in her bed, the waggons with the

treasure of the 'Hermione' entered St. James's Street; on which His Majesty and the nobility went to the windows over the palace-gate to see them, and joined their acclamations on two such joyful occasions; from whence the procession proceeded to the Tower in the following order, viz.:—A company of light horse, attended with kettle-drums, French horns, trumpets, and hautboys. A covered waggon, decorated with an English jack, and a Spanish flag underneath, hanging behind the waggon. Two more covered waggons. Seven waggons uncovered. And, lastly, a covered waggon, decorated with an English jack and a Spanish flag. In the whole twenty waggons. The procession was concluded with an officer on horseback, carrying an English ensign, attended by another holding a drawn cutlass. The escort to each waggon consisted of four marines with their bayonets fixed. The whole cavalcade was saluted by the people with acclamations of joy. On opening some of the chests at the Bank they were greatly surprised to find a bag full of gold instead of silver in one of them; several have since been found of the same kind."* The treasure weighed sixty-five tons, and was valued at nearly a million sterling. In the last incident of this kind we shall mention, which occurred just a century before, the money was obtained without violence of any kind from its owners, yet not the less disgraceful was its possession. It was the purchase-money of Dunkirk, acquired by Cromwell, and so much valued by the English people, that just before the sale was concluded the merchants of London offered through the Lord Mayor any sum of money to Charles rather than it should be lost. The offer, however, was declined. We have already, in our account of the Tower, noticed Charles's visit there to see the wealth he had so dearly purchased. Pepys had a hope of getting some portion of the treasure to pay off the naval arrears, but the king knew better how to dispose of it than on such merely national purposes.

These passages refer to one of the extraordinary modes of supplying the Mint with bullion. Another proposed method, which has engaged a great deal of attention, is of a very interesting, though, unfortunately for its projectors, not of a very practical character. The name of Raymond Lully, the alchemist, is well known. He was the chief of those who, in the middle ages, helped to spread abroad through Europe a belief in the possibility of transmuting the baser metals into gold. He appears to have been a simple-minded, enthusiastic man, who in this matter probably imposed upon himself by his discoveries in the then wonderful science of chemistry. His chief object, to which he adhered with the most exemplary fortitude through all kinds of difficulties and dangers, was the conversion of the Mohammedans; and when he came to England, during the reign of Edward I., it was to engage that monarch in some new holy war. Edward had, however, plenty of business on hand with the Scotch and Welsh patriots; but the temptation held out by Lully was irresistible, being no less than that of filling his treasury on the cheapest possible terms. The alchemist set to work in "the chamber of St. Katherine" in the Tower; and Ashmole says, "gold is affirmed, by an unwritten verity, to have been made . . . and, besides the tradition, the inscription is some proof, for upon the reverse is a cross fleury, with *lioneux*, inscribed, *Jesus autem transiens per medium illorum ibat*, that is, as Jesus passed invisible and in the most secret manner by the midst of the Pharisees, so

* Gent. Mag. Aug. 12, 1762.

that gold was made by invisible and secret art amidst the ignorant.* Ashmole here refers to an inscription first seen on the gold noble of Edward III., and continued on various coins down to the period of Elizabeth. Much speculation has been excited by it, but to little purpose. The reader may wonder why the work did not proceed, since the great secret was discovered. It appears that, after a time, Edward refused to keep his promise, and Lully, on his part, declined any longer making the King rich. He was, in consequence, confined in one of the Tower dungeons. Such is the story; and it does not seem very difficult to extract from it the essential truth, that alchemy was yet to be ranked amongst the undiscovered secrets of science. Not such was the conclusion of the government. One of the most curious parts of the history of the Mint is the continual faith our sovereigns have had in being able to supply it with cheap gold and silver. The patent roll of the third year of Edward III.'s reign states that the King had been given to understand that John le Rous and Master William de Dalby could make silver by art of *alkemony*; that they had heretofore made it, and still did make it; and that by such making of that metal they could greatly profit the realm. He therefore commanded Thomas Carey to find them out, and to bring them before the King, with all the instruments, &c., belonging to the said art. If they would come willingly, they were to be brought safely and honourably; but if not, they were to be seized and brought before the King, wherever he might be. All sheriffs, &c., were commanded to assist the said Thomas Carey. Either rumour had a little enhanced the skill of "John le Rous and Master William de Dalby," or they had themselves assumed too readily their "blushing honours," for no alchemic money poured into the Mint in consequence of the mandate. In the reign of Henry VI. the tempting cup of wealth seemed again brought to the royal lips. In that monarch's twenty-second year John Cobbe presented a petition to the King, stating that he was desirous of operating upon certain materials by art philosophical, viz., to transubstantiate the inferior metals, by the said art, into perfect gold and silver, so as to endure every trial; but that certain persons had suspected this to be done by art unlawful, and therefore had power to hinder and disturb him in giving proof of it. The King, in answer, granted a special licence of protection, and, hoping at least to find among a multitude of alchemists the treasure he desired, soon after bestowed a similar mark of his grace on several other persons. Growing more and more impatient for some tangible result, in his thirty-fifth year he appointed a commission to inquire into the truth of the art, the professors of it having promised him wealth enough to pay all his debts in gold and silver, to the great advantage of the kingdom. The members consisted of Augustine and Preaching friars, the Queen's physician, the master of St. Laurence Pontigny College, an alderman of London, a fishmonger, two grocers, and a mercer—certainly one of the oddest mixtures of persons for a tribunal of judgment on a scientific question we ever remember to have read of. The result must have been, we should suppose, partially favourable, for two years later we find the King again granting a licence for the pursuit. The people's faith in alchemy, during all this period, seems to have been no less earnest than that of their sovereign, but it was a faith of a

* Ashmole's *Theatrum Chemicum Britannicum*. The translation of the inscription is, however, a very loose paraphrase. Literally it is—"Jesus passing over went through the midst of them."

very different nature. They appear to have believed that gold and silver might be made, but only by the assistance of the Evil One. An alchemist was a wiser, subtler, and infinitely more mischievous sort of witch, one who would soar above the vulgar desire of sticking pins into people, and preventing butter from being churned, in order to play at ducks and drakes with the national money. Many and many a time, no doubt, has the rustic (and perhaps even higher than he), when he has heard some of the marvellous tales of the alchemists and the Mint, blessed himself as the thought crossed him that his little hoard might be of money made in the mysterious way, and gone to look at it once more to be sure that it had not disappeared. We have already seen that John Cobbe was obliged to petition the King for a licence, on the ground of having been disturbed by persons who suspected him to practise by *art unlawful*; another evidence of a similar kind, and in connexion with a new instance of the royal hankering after this "new way to pay old debts," occurs in the Leet Book of the corporation of Coventry, under the date of the 6th of January, in the seventeenth year of the reign of Henry's conqueror and successor, Edward IV. "The mayor received a privy signet by the hands of a servant of the King, the tenor whereof after ensueth: 'By the King.—Trusty and well-beloved, we greet you well, and let you wite (know) that it hath been showed unto us that our well-beloved John French, our servant, com'inyng [*query*, coming in] and commonly abiding in our city there, intendeth by his labour to practise a true and a profitable conclusion in the cunning of transmutation of metals, to our profit and pleasure; and for to make a clear showing of the same before certain our council and servants by us therefore appointed, is required a certain time to prepare his materials: we, not willing therefore our said servant to be troubled in that he shall so work or prepare for our pleasure and profit, will and charge you that ye ne suffer him in any wise by person or persons to be letted, troubled, or vexed of his said labour and practice, to the intent that he at his good liberty may shew unto us, and such as be by us therefore appointed, the clear effect of his said conclusion. Given under our signet, at our palace of Westminster, the 29th day of December.'" The excessive courteousness of tone perceptible in this epistle will not escape observation. From this time, if the art of alchemy still continued for a time to find believers, the sovereigns of England appear to have grown too wise by experience to rank themselves publicly among the number.

The establishment of the Mint in London must date from the remotest periods of the known history of the latter. There can be no doubt some of the Roman emperors coined money here, and specimens bearing the name of London in an abbreviated form still exist. In the Saxon period, also, we know not only that London had a Mint, but that it was the chief one in the kingdom. There were eight moneyers (as the chief officers were called, to whom the coining of money was intrusted in early times) in London in the reign of Athelstan, and six at Winchester, the next place in rank. The Mint in the Tower is as old as the erection; and it has been worked in every reign from the Conquest to the present time, with one or two unimportant exceptions. In treating of the "Mint" through the remainder of this article, we propose to direct our attention chiefly to the *growth of our national coinage*, as illustrated by the introduction of the most important new coins from time to time into it. The engravings introduced will at the same time show the nature and extent of its artistical progress, from

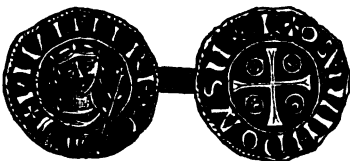
the earliest period up to that of the Commonwealth; for since then, if there has been progress at all, it has been in the wrong direction. This is no place to enter into disquisitions on the uncertain subject of the money of the ancient Britons, of the Roman-British, or of the Saxons: suffice it, therefore, to observe that to the period of the first are assigned the ring coins of the character here represented; to that of the second the rude coins, bearing some—incriptions



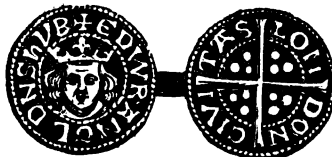
[Ring Coins.]

supposed to refer to Boadicea, and others to Cunobelin, a British king of the time of Augustus; whilst to the third may be assigned the first real coin having a direct connexion with our present system. The silver *penny* is first mentioned in the laws of Ina, king of the West Saxons, who reigned from 689 to 726. It most probably derived its name from the word *pendo*, to weigh, being then, as now, the 240th part of a pound. Its weight was $22\frac{1}{2}$ grains, and would now be worth $2\frac{1}{2}d$. This coin was for several centuries the chief circulating medium. "The silver penny of Alfred," says Ruding (to whom we must express our obligations), "is the first authentic coin yet discovered which can with certainty be appropriated to the London Mint." The history of the silver penny offers a good illustration of the disgraceful as well as foolish system adopted by our older sovereigns of depreciating the real value of coin, in the hope of preserving at the same time the original current value. From $22\frac{1}{2}$ grains, in the Anglo-Saxon period, it had fallen to 18 grains by the reign of the third Edward, to 12 grains

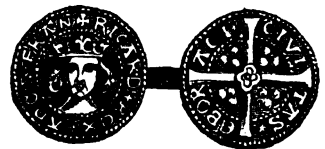
SILVER PENNIES.



[William I.]



[Edward I.]



[Richard II.]

by the reign of the fourth Edward, to 8 grains by the reign of the sixth Edward, and during the reign of Elizabeth was fixed at 7½ grains, its present weight. The silver halfpenny and farthing are both mentioned in the translation of the Saxon gospels; they would now be worth respectively about 1½*d.* and ¾*d.*: these also continued for several centuries in circulation. The last halfpenny was struck during the Commonwealth; the last farthing in the reign of Edward VI. Next in antiquity to the Saxon penny is the *styca*, or copper money of the kings of Northumberland, and which appear to have been confined to that kingdom. Their date is from 670 to about the close of the ninth century. The *styca* would now be worth about a third of a farthing.

The rudeness of the money during these early times, and of the system under which they were coined, offered a wide field for knavery; and the consequence was that the currency was at all times in a deplorable state. Punishments more and more severe were tried on the great offenders, who were the moneyers themselves, but with only the most temporary benefit. We learn that in the reign of Edgar the penny had become at one time scarcely equal to a halfpenny in weight; and on one Whit Sunday, St. Dunstan, who had become very indignant at this state of things on the part of the public officers, refused to celebrate mass till three moneyers had received immediate punishment. Accordingly their right hands were struck off. A more frightful instance of the kind occurred in the reign of Henry I., the "Lion of Justice" as he has been called, who had a very significant testimony of the baseness of his money in the refusal of dealers to take it in the market. He was then in Normandy, but, determined upon swift and sweeping vengeance, he sent over his mandate to Roger, Bishop of Salisbury, to summon the moneyers throughout England to appear at Winchester against Christmas Day. As they arrived, they were taken apart singly, and underwent the most cruel and disgraceful mutilations. They were afterwards driven into banishment. Three alone out of ninety-four persons escaped punishment, and to them was committed the charge of making a new coinage to supply the whole kingdom. The rudeness of the money offered, of course, facilities to others beside moneyers for living upon the coinage. Makers and utterers of false coin flourished. In a curious anecdote of King John and Pandulph, we see that even learned ecclesiastics occasionally were to be found in their ranks. Immediately after sentence of excommunication was pronounced on John by Pandulph at Northampton in 1212, the King, doubtless with the view of intimidating Pandulph for continuing the interdict he had promulgated, ordered the sheriff to bring before him all the prisoners then in his custody. Some of these he caused to be hung, some to have their eyes torn out, and some their feet cut off. Among the prisoners was a priest, a clerk, who had counterfeited money, whom the King ordered to be hanged. Pandulph at once stepped forward, and threatened to excommunicate whoever should touch the priest, and went himself in search of a candle to fulfil his determination. John was now frightened, and, following the legate, delivered the prisoner into his hands that he might himself execute justice upon him. The latter, however, was immediately set at liberty. The chief offenders against the King's coin, if history has not belied them, were the Jews, of whom no less than 280 persons of both sexes were hung in London alone by Edward I. His bigotry against them, coupled with his

rapacity, which their wealth was so well able to gratify, may account for a great part of these horrible proceedings, without taking it for granted that his Jewish were so infinitely worse than his Christian subjects. But Edward did not punish only. He was too much of the statesman to allow all the evils of his monetary system to remain unchecked, save by the irregular operation of such influences: to him the Company of Moneyers are indebted for a confirmation of the privileges they still enjoy (including the great one of being the only national coiners), and most probably also for a general consolidation and improvement of their body, so as to make it more responsible; for we find that by the following reign the reformation of the Mint may be said to have been essentially completed: then an officer called the Comptroller was appointed, who, like the Warden and the Master, was to send in his accounts separately. From this time no fraud could take place without the conjunction of the three officers. The Company now consists of seven senior and junior members and a provost, who undertake the coinage at fixed prices.

The improvements carried into effect among the coiners appear very wisely to have been closely connected with a similar reformation of the coinage. From the reign of Henry III. English money begins to improve in appearance, as well as to exhibit more variety: According to a manuscript chronicle in the archives of the city of London, the King, in 1257, made a penny of the finest gold, which weighed two sterlings, and willed that it should be current for twenty pence. This was the first English coinage of gold. Under the date of Edward I.'s reign, our old writers speak of a coinage of silver halfpennies and farthings, then for the first time made round, instead as of old, square. These new coins were issued in 1279, and are connected with an interesting story. An old prophecy of Merlin had declared that whenever the money of England should be round, the Prince of Wales should be crowned in London. Llewellyn, the last prince, was slain by Edward in 1282: his head was cut off and sent to London, where it was placed in the Tower, crowned with willows, in mockery either of its late unhappy owner's pretensions or of the prophecy.



[Silver Groat of Edward III.]

[Gold Noble of Richard II.]

Edward III. introduced several new coins into circulation, namely, the gold florin, with its half and quarter; the gold noble, also with its divisions; the groat and the half-groat. The gold florin, intended to pass for six shillings, now worth about nineteen, was found an inconvenient sum, and also, it is said, priced beyond its real value: so it soon gave place to the gold noble, or rose noble, as it was sometimes called, of the value of 6s. 8d., or half a mark. On this coin we per-

ceive Edward, completely armed, in a ship—a reference most probably to his great naval victory over the French at Sluys in 1340, when the latter lost from ten to fifteen thousand men. This is the coin bearing the extraordinary legend before mentioned, and which was supposed in ancient times to have been made of Lully's wondrous gold. The noble of Richard II. (shown above) is almost an exact fac simile of this famous coin, which was subsequently (temp. Henry VI.) raised to the value of ten shillings, and called the rial. The silver groat borrowed its name from the French word *gros*, and was no doubt so designated from its being the largest piece then known.

No new coins appeared from this time until the reign of Edward IV.; but a story of a remarkable kind is told by Speed, Hollinshed, and other writers, of which, according to a high authority, the silver coins of Henry V. probably present a permanent memorial. In the coin here shown the reader will perceive



[Silver Groat of Henry V.]

below the flowing hair small round circles. These are the only distinguishing features of Henry V.'s coin from his father's, and are, it is supposed, "intended for eyelet holes, from an odd stratagem when he was prince."* The following account of the "odd stratagem" is from Speed. The period referred to is the latter part of Henry IV.'s reign, when the King being "somewhat crazy, and keeping his chamber, hearing news daily of his son's loose exercises, too mean for a prince, and their constructions—(ever made to aim at his crown), he began both to withdraw his fatherly affection, and to fear some violence against his own person; which, when Prince Henry heard of, by some that favoured him of the King's council, in a strange disguise he repaired to his court, accompanied with many lords and noblemen's sons. His garment was a gown of blue satin, wrought full of eyelet holes, and at every eyelet the needle left hanging by the silk it was wrought with. About his arm he wore a dog's collar, set full of SS of gold, the turrets thereof being most fine gold. Thus coming to Westminster and the court of his father, having commanded his followers to advance no farther than the fire in the hall, himself, accompanied with some of the King's household, passed on to his presence, and, after his duty and obeisance done, offered to make known the cause of his coming. The King, weak then with sickness, and supposing the worst, commanded himself to be borne into a withdrawing chamber, some of his lords attending upon him, before whose feet Prince Henry fell, and with all reverent obeisance spake to him as followeth:—'Most gracious sovereign and renowned father, the suspicion of disloyalty and divulged reports of my dangerous intendments towards your royal person and crown hath enforced at this time and in this manner to present myself and life at your Majesty's dispose. Some

* Leake's History of British Money.

faults and misspent time (with blushes I may speak it) my youth hath committed, yet those made much more by such fleering pickthanks that blow them stronger into your unwilling and distasteful ears. The name of sovereign ties allegiance to all; but of a father, to a further feeling of nature's obedience: so that my sins were double if such suggestions possessed my heart: for the law of God ordaineth that he which doth presumptuously against the ruler of his people shall not live, and the child that smiteth his father shall die the death. So far therefore am I from any disloyal attempts against the person of you, my father and the Lord's anointed, that if I knew any of whom you stood in the least danger or fear, my hand, according to duty, should be the first to free your suspicion. Yea, I will most gladly suffer death to ease your perplexed heart; and to that end I have this day prepared myself, both by confession of my offences past, and receiving the blessed sacrament. Wherefore I humbly beseech your Grace to free your suspicion from all fear conceived against me with this dagger, the stab whereof I will willingly receive here at your Majesty's hand, and so doing, in the presence of these lords, and before God at the day of judgment, I clearly forgive my death.' But the King, melting into tears, cast down the naked dagger (which the prince delivered him), and raising his prostrate son, embraccd and kissed him, confessing his ears to have been over-credulous that way, and promising never to open them again against him. But the prince, unsatisfied, instantly desired that at least his accusers might be produced, and, if convicted, to receive punishment, though not to the full of their demerits: to which request the King replied that, as the offence was capital, so should it be examined by the peers, and therefore willed him to rest contented until the next parliament. Thus by his great wisdom he satisfied his father from further suspicion, and recovered his love that nearly was lost."*



[Angel of Edward IV.]

The gold angel, and angelet or half-angel, were first struck by Edward IV. in 1466, and were intended to pass in the room and at the value of the noble and



[Sovereign of Henry VII.]

* Speed's History of Great Britain, ed. 1632, p. 767.

half-noble, but were considerably inferior in intrinsic value. The next new coins issued from the Mint during the reign of Henry VII.: these were the sovereign, with its double and half, of gold, and the testoon or shilling of silver. The term shilling is, at least, as old as the Saxon period, when, however, it expressed money of account only: it now became a coin of currency. The name testoon



[Groat or Shilling of Henry VII.]

[The George Noble of Henry VIII.]

was derived from the French word *teste* or *tête*, a head, the royal portrait being stamped in the novel form of a profile. The coin itself was often called a groat. The testoon in the course of a reign or two obtained a bad reputation, having become greatly debased. Heywood has several epigrams on the subject. Here is one of them:—

“ These testoons look red ; how like you the same ?
 ’Tis a token of grace : they blush for shame.”

The debasement here referred to commenced with the reign of Henry VIII., who, to the other characteristics of his reign, added the feature that he was the first English sovereign who corrupted the sterling quality of his coin. His predecessors had often tried the effect of making a small piece of silver or gold pass for the value of larger ones ; but in some cases this may have arisen from erroneous notions as to the laws which govern the value of money, and, at the worst, it was a sort of frank dishonesty : it was reserved for “ bluff King Hal ” to try to cheat the nation ; to keep the coin of promise to the eye, but break it to the hope ; to place, in a word, the British Government on the level of the poor wretches who were being continually strung up for the same crime, without having the same excuse for its commission. Among the coins struck by Henry VIII. may be mentioned the George noble, so called from the representation of St. George and the Dragon stamped on the reverse. A specimen of a silver crown-piece was coined by Henry, but that coin was first issued for currency by his son Edward, with the half-crown, sixpence, and threepence.

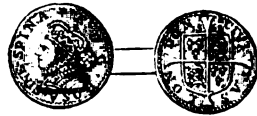


[Crown of Edward VI.]

During this reign the corruption of the coin was carried even still further. Henry had reduced the proportions of his silver from eleven ounces two pennyweights of the pure metal and eighteen pennyweights of alloy, to four ounces of silver and eight of alloy. Edward's government now left only three ounces of silver in the pound of mixed metal. Old Latimer, in one of his sermons (1548), complains bitterly of the interference of the ecclesiastics of his day in the affairs of government: "Some," he says, "are ambassadors, some of the privy council, some to furnish the court, some are lords of the Parliament, some are presidents, and some *comptrollers of Mints*. Well, well, is this their duty? Is this their office? Is this their calling? Should we have ministers of the church to be comptrollers of the Mint? . . . I would fain know who comptrolleth the devil at home at his parish while he comptrolleth the Mint?" The honest bishop was also very probably thinking at the same time *how* the Mint was comptrolled by them, but left that part of the business untouched, as being beyond his sphere. All this evil was now to be remedied, and, above most other features, the reformation of the coinage is the one perhaps that adds the greatest lustre to the reign of the virgin queen. In our account of the Exchange, we have had occasion to show that Sir Thomas Gresham was one of the most strenuous promoters of this reformation, if indeed he was not its chief originator. The silver was now restored to its original proportions of eighteen pennyweights of alloy in the pound of standard metal, which are also the proportions observed to this day. In making this alteration it was necessary to recall the corrupt coin of her brother and father, and melt it down for re-casting. The real value of what was received at the Mint for this purpose was about 244,000*l.*, *its current value having actually been 638,000*l.** Whilst the process of reformation was going on, Elizabeth went publicly to the Tower, where she coined several pieces with her own hand, and distributed them among her suite. This queen added silver three-halfpenny and three-farthing pieces to the money of England; and during her reign the first milled money appeared; the "mill-sixpences" of which Master Slender was robbed.



[Milled Sixpence of Elizabeth.]



[Three-farthings of Elizabeth.]

During the period commencing with the reign of Charles I. and ending with that of his son, the history of the Mint is highly interesting; we can here only notice in the fewest words its chief points. One of Charles's most despotic acts in the contest with the Parliament was the seizing the money placed in the Mint by the merchants of London (a custom with them at that time) to the amount of 200,000*l.*, and, like most of his other acts of a similar nature, recoiled terribly upon himself: some of the most influential moneyed men of the empire were made hostile to him. The coins of Charles I. are in themselves a history of his

subsequent life, showing in the variety of their shape and the places of their coinage the troubled character of the period, and the shifts to which he was continually reduced. We have them lozenge-shaped, round, and octangular; and others again are small bits of silver plate, an inch and a half long, with a scarcely legible drawing of a castle. Among the places of mintage we find Oxford, York, Shrewsbury, Newark, Carlisle, Pontefract, &c. Silver ten and twenty shilling pieces were struck by Charles. In marked contrast with the money current during the war appears that of the Commonwealth when the contest was over. Unquestionably the finest coins we can boast of belong to the period in most other respects so unfavourable to the arts. Prior to the war Nicholas Briot, a French engraver, had produced for Charles I. the most beautiful money then known: it was a pupil of Briot's, Thomas Simon, who, in the service of Cromwell, outstripped his master, and produced the coins here shown, in which the bust of the great Protector is considered to be, with few exceptions, the most masterly



[Silver Crown of Cromwell.]

production of any modern artist who has exhibited his genius in this mode. It is probable that Simon's very excellence in connexion with such a subject was his dire offence when Charles II. came to the throne. How else are we to account for the treatment he then received? He was superseded; and although in a generous spirit of emulation he prepared a crown-piece, esteemed to this day one of the noblest specimens of medalling known, and presented it to the King, with a petition for his restoration, the application was unsuccessful. We must not quit the subject of the Commonwealth money till we have referred to the coins which so long furnished a standing joke for the Cavaliers. These appeared before Cromwell's appointment as Protector, and presented on the one side the English arms, and on the other the arms of England and Ireland, with the inscription "God with us." One Royalist jest was, that it appeared from their own coin that God and the Commonwealth were on different sides; another, that the two shields were the breeches of the Rump Parliament: this last was a prolific source of amusement. So late as 1731, we read in a prologue, spoken in Bury School, of

"A silver pair of breeches neatly wrought,
Such as you see upon an old Rump groat,
Which emblem our good grandsires chose to boast
To all the world, the tail was uppermost."*

* Gent.'s Mag., 1731.

We may now dismiss rapidly the only remaining coins that require notice. The guinea was coined by Charles II., and was so called as being made from the gold brought over by the African Company from Guinea, whose stamp, the elephant, appears upon all the coins made from their bullion. Accompanying the guinea were struck in the same reign the five-guinea piece, the two-guinea, and the half-guinea. The present copper coinage of halfpennies and farthings also dates from Charles's reign; and the figure of Britannia, still preserved, was modelled after the celebrated Miss Stewart, afterwards Duchess of Richmond. Charles II. also coined a tin farthing, with a stud of copper in the centre. James, and William and Mary, continued that coin, and added a halfpenny of the same kind. This tin coinage was recalled in 1693. The reign of William and Mary is memorable in the history of the Mint, from another great reformation of the coinage, which had become so much depreciated by clipping, that 572 bags of silver coins brought into the Mint in 1695, which ought to have weighed above 18,450 lbs., did actually weigh but a little more than half, or 9,480 lbs. This single re-coinage must have cost the Government nearly two millions. Anne's reign is chiefly noticeable to the connoisseur in coins for the famous farthings, about which there has been so much misunderstanding. A complete set of this Queen's farthings comprise no less than six different coins, though these are all more or less rare, but in particular the one here



[Queen Anne's Farthing.]

engraved, which is consequently valuable. The gold quarter-guinea was coined by George I., and is remarkable as bearing for the first time the letters F. D. (Fidei Defensor). Gold seven-shilling pieces and copper pennies and twopences first appeared during the reign of George III.; both the first and the last have since been withdrawn. The guinea and half-guinea were withdrawn in 1815, when they were replaced by the present sovereign and its half. The last new piece added to our coinage was the fourpenny-piece by William IV. in 1836, which is of a different type from the existing groat.

Till the present century the Mint remained in the Tower. But about 1806 the Government, finding the military department had greatly encroached upon the buildings originally used for coining, intrusted to Sir Robert Smirke the erection of a new edifice upon Tower Hill. It was completed about 1811, at an expense of above a quarter of a million of money. This immense sum, however, included Boulton's expensive machinery, which, by successive improvements, has been brought to such a surprising degree of perfection, as, in conjunction with the other admirable arrangements of the establishment, places a power at the disposal of the Moneyers that will enable them, if required, to receive fifty thousand pounds worth of gold one morning in bullion, and return it the next in coin. It is amusing to contrast this rapidity with the state of things existing when every

piece was struck by hand, or when the entire process of coining could be carried on in a single room, as we see it in the engraving at the end of this paper, which evidently agrees in its essentials with the old English methods. In the present interesting process of coining the ingots are first melted in pots, when the alloy, of copper, is added (to gold, one part in twelve; to silver, eighteen pennyweights to a pound weight), and the mixed metal cast into small bars. And now begin the operations of the stupendous machinery, which is unequalled in the Mint of any other country, and is in every way a triumph of mechanical skill. The bars, in a heated state, are first passed through the breaking-down rollers, which, by their tremendous crushing power, reduce them to only one-third their former thickness, and increase them proportionally in their length. They are now passed through the cold rollers, which bring them nearly to the thickness of the coin required, when the last operation of this nature is performed by the draw-bench—a machine peculiar to our Mint, and which secures an extraordinary degree of accuracy and uniformity in the surface of the metal, and leaves it of the exact thickness desired. The cutting-out machines now begin their work. There are twelve of these engines in the elegant room set apart for them, all mounted on the same basement, and forming a circular range. Here the bars or strips are cut into pieces of the proper shape and weight for the coining-press, and then taken to the sizing-room to be separately weighed, as well as sounded on a circular piece of iron, to detect any flaws. The protecting rim is next raised in the marking-room, and the pieces after blanching and annealing are ready for stamping. The coining-room is a magnificent-looking place, with its columns and its great iron beams, and the presses ranging along the solid stone basement. There are eight presses, each of them making, when required, sixty or seventy (or even more) strokes a minute; and as at each stroke a blank is made a perfect coin—that is to say, stamped on both sides, and milled at the edge—each press will coin between four and five thousand pieces in the hour, or the whole eight between thirty and forty thousand. And to accomplish these mighty results the attention of one little boy alone is required, who stands in a sunken place before the press, supplying it with blanks. The bullion is now money, and ready for the trial of the Pix, which, at the Mint, is a kind of tribunal of judgment between the actual coiners and the owners, as the greater trial known by the same name in the Court of Exchequer is to test the quality of the money as between the Master of the Mint and the people. This trial generally takes place on the appointment of a new master before the members of the Privy Council and a certain number of the Goldsmiths' Company; from the latter a jury of twelve persons is sworn. The Lord High Chancellor, or, in his absence, the Chancellor of the Exchequer, presides. Ruding was present at the trial of the Pix in 1799, when, after a variety of minute experiments, it was found that a certain quantity of gold which should have weighed 190 pounds, 9 ounces, 9 pennyweights, and 15 grains, did weigh just 1 pennyweight and the 15 grains less: a closeness of approximation sufficient, no doubt, to satisfy the nicest tribunal.

At the time at which we are writing it has been announced that some change or re-coinage of our gold money is in meditation. It may be worth while therefore to recall an idea put forth by Swift on a somewhat similar occasion. In 1712 he delivered to the Lord Treasurer a plan for the improvement of the British

coinage, which, among other matters, proposed that they should *bear devices and inscriptions, alluding to all the more remarkable parts of the sovereign's reign.* "By this means," he says, "medals that are at present only a dead treasure, or mere curiosities, will be of use in the ordinary commerce of life, and at the same time perpetuate the glories of her Majesty's reign, reward the labours of her greatest subjects, keep alive in the people a gratitude for public services, and excite the emulation of posterity. To these generous purposes nothing can so much contribute as medals of this kind, which are of undoubted authority, of necessary use and observation, not perishable by time, not confined to any certain place; properties not to be found in books, statues, pictures, buildings, or any other monuments of illustrious actions."*

* Guardian, No. 96.



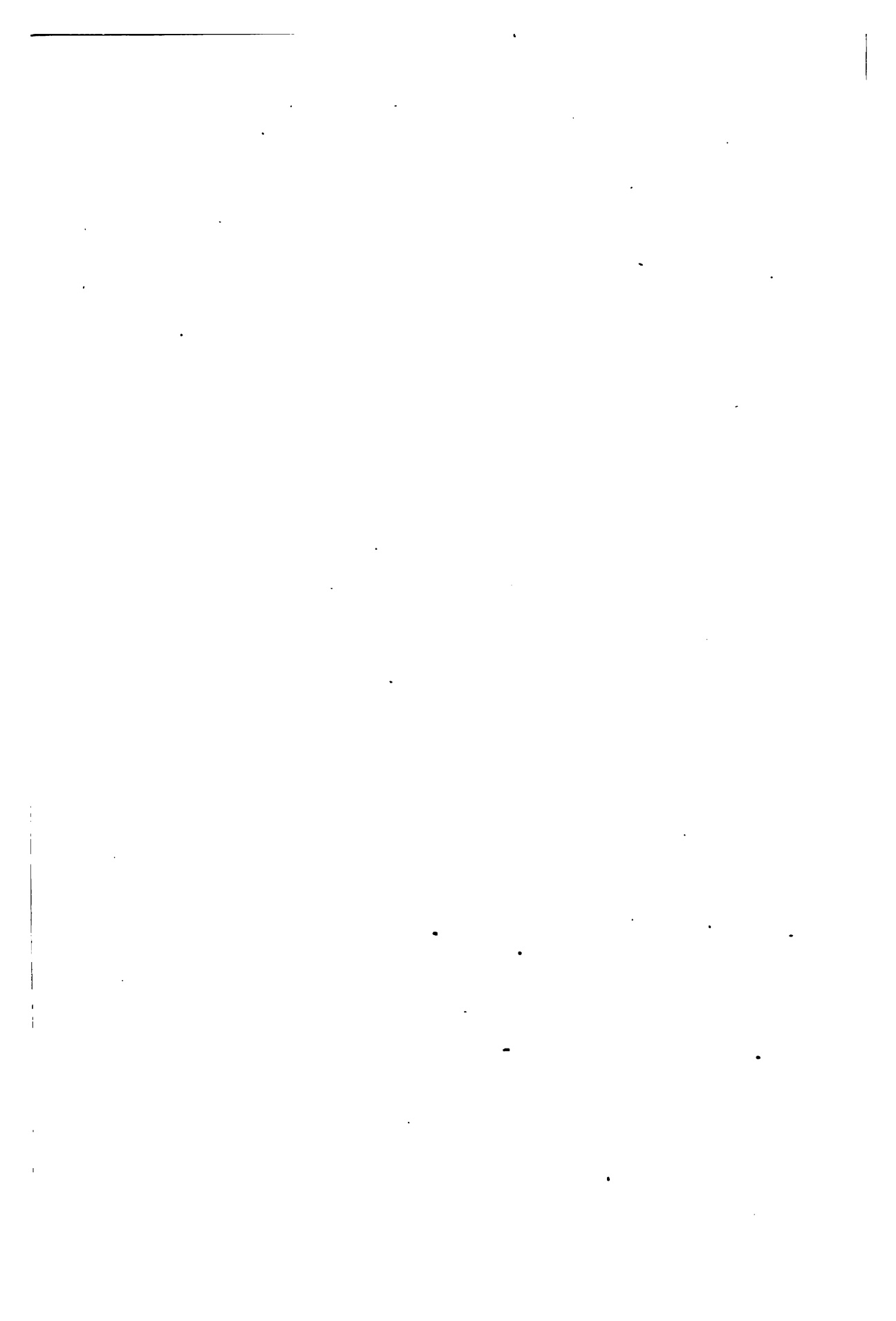
[Process of Coining.]

published 19 March 1842





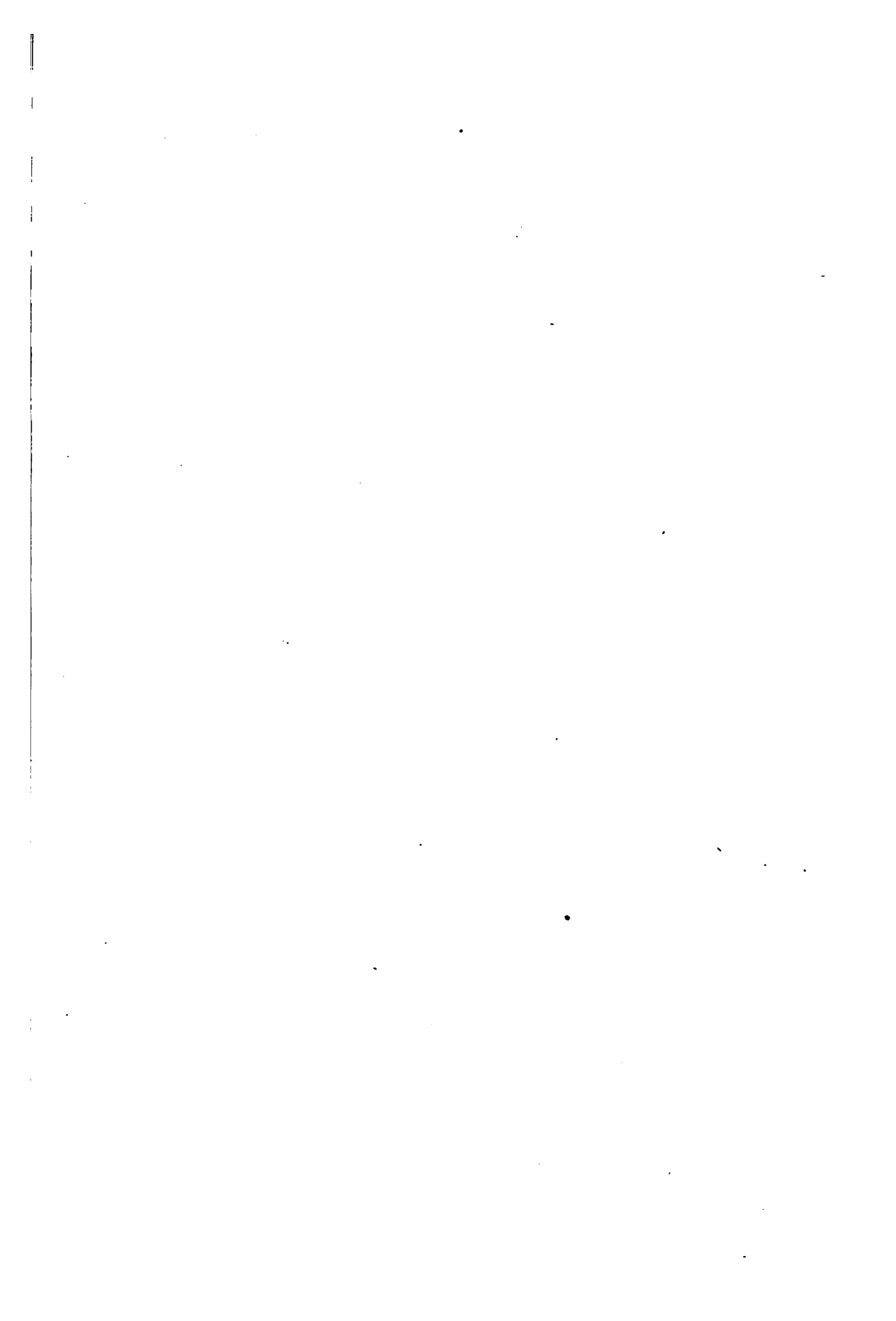




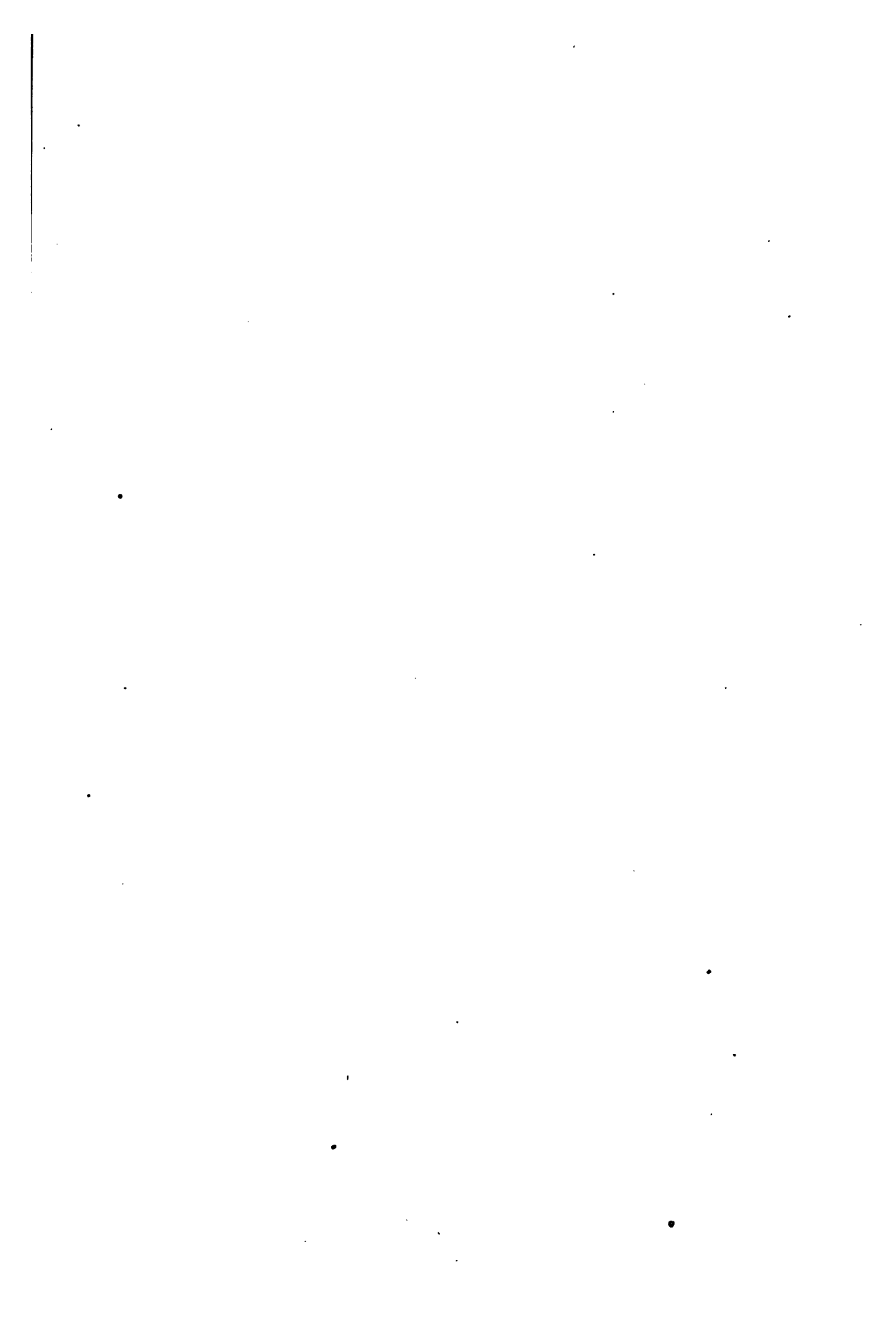


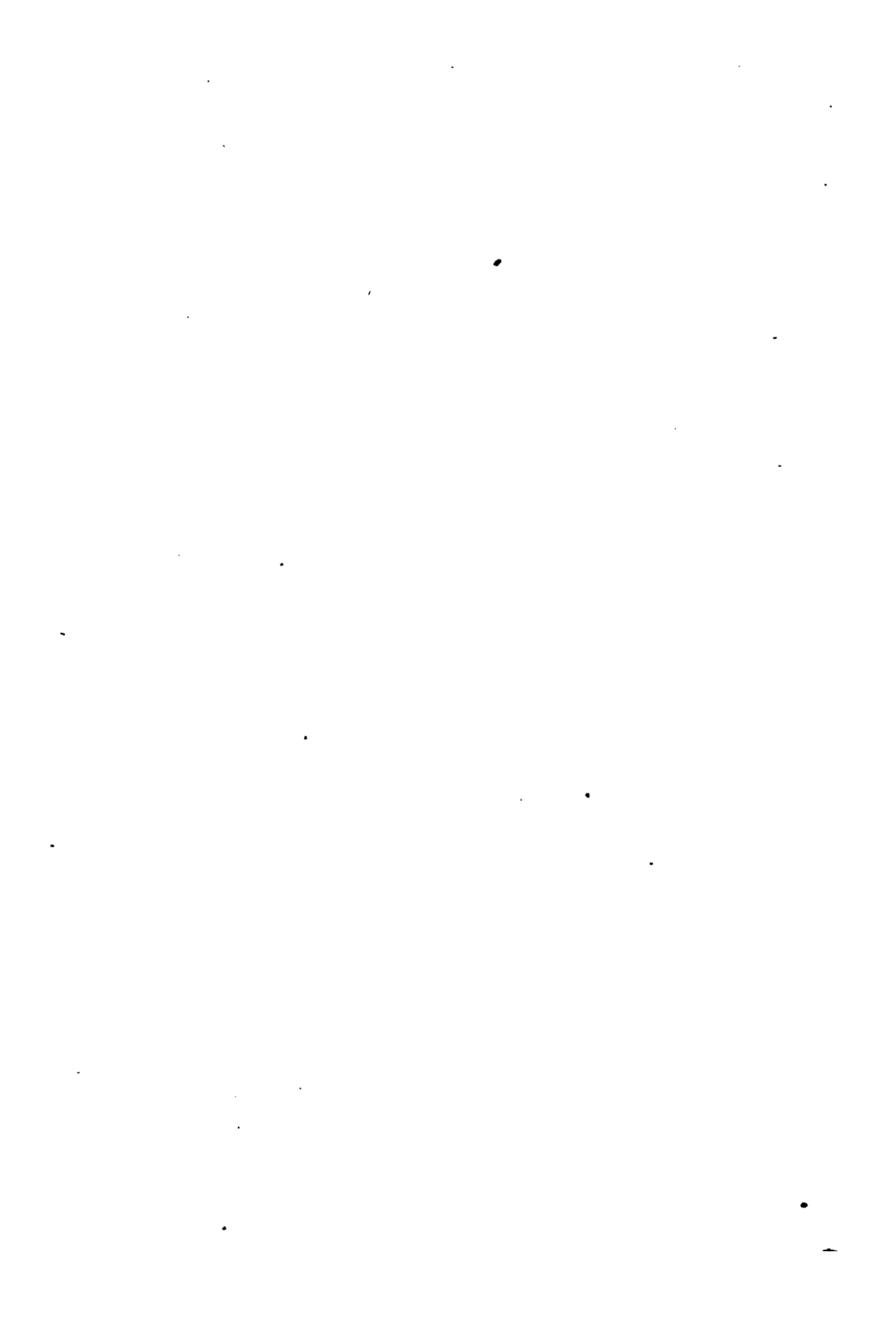










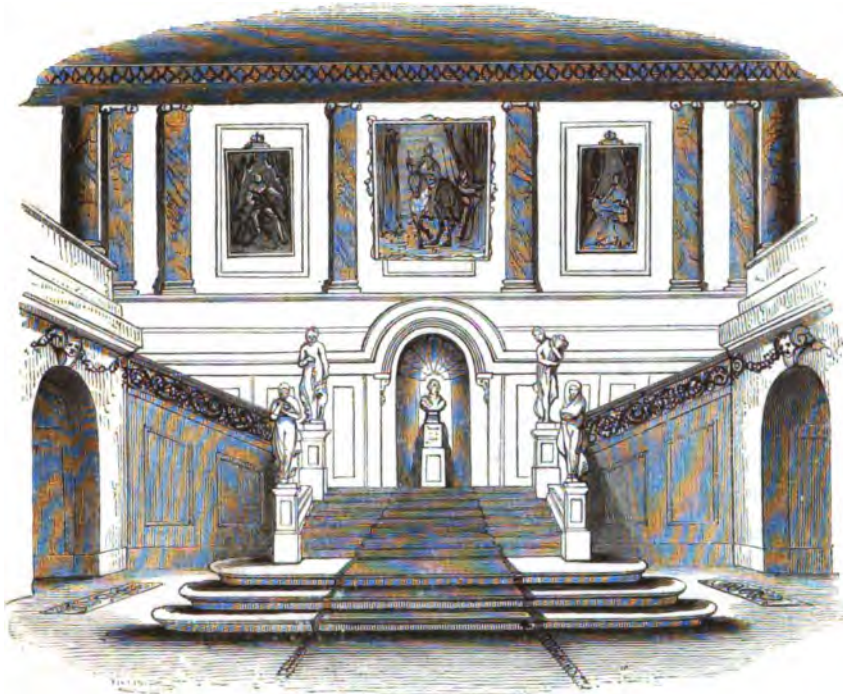












[Staircase, Goldsmiths' Hall.]

LXXV.—GOLDSMITHS' HALL.

WE will not say,—in imitation of the well-known phrase, He who has not seen Paris has seen nothing,—he who has not seen the Goldsmiths' Hall has not seen London; but it may be safely asserted that, without a glance into the interior of this noble building, no one can form a just conception of the wealth, luxury, and, we must add, taste, of some of our great civic companies; which, however they may now have ceased to be identified with any very large portion of the commercial greatness of London, were undoubtedly the originators of that greatness, and the guardians through all sorts of troublous times of the comparatively free and enlightened principles on which alone commercial prosperity can be based. But those times are now past; and the Companies generally, like the victors in a good fight, seem to have little else to do but to sit down, eat, drink, and make merry, and discourse of all the alternations of good and evil fortune by which the previous contest was marked. Grasping monarchs can no longer haunt their visions with fines and rumours of fines, as the price of the maintenance of their rights; needy ones can no longer hold out the expectation of fresh privileges to be obtained by the all-persuasive mediation of citizen gold. But with the conflict and the danger, the glory and the influence have passed away. Trade, so much indebted to them whilst yet but a young weakling, has grown

strong and robust, and can take excellent care of himself. The leading-strings of one day have become shackles at another; and so the giant throws them off, or bursts through them. Let him not, however, forget what he was; or be ungrateful to those who have aided so greatly to make him what he is.

The Goldsmiths' Company, more fortunate than most of its early brethren, is still essentially a business Company. It has so happened that the peculiar privilege intrusted to them from a very early period, of assaying and stamping articles made of the precious metals, has not been found to be attended with any important disadvantages; so in their hands the privilege still remains,* notwithstanding the enormous increase of business that must have taken place. This circumstance to a certain extent favourably distinguishes the Goldsmiths' Company† from the other great civic Companies, and promises to it a longer lease of power and consideration.

He who has once seen the present Hall of the Company will not forget its position at the back of the Post Office; for the very circumstance that such a magnificent building should be so curiously and badly situated strikes every one with surprise. There it is, however, not yet eight years old; and, consequently, there for the next two or three centuries we may be sure it will remain. Of course, this is a matter over which the architect, Mr. Hardwick, could have no control. Perhaps the best, or at least the most convenient way, to enjoy the view of its exterior, is to pass from St. Martin's-le-Grand through the Post Office, and there, standing on the top step, and leaning your back against the wall, the eye at once takes in two fronts of the building, the superb west or principal façade, one hundred and fifty feet broad, with its attached Corinthian columns and beautiful Italian windows; and the south, one hundred feet broad, with its decorating pilasters. In some respects the enforced proximity of the spectator to the building is advantageous; as, for instance, in following the details of the beautiful Corinthian entablature, which is supported by the entire front of the western façade, and continued quite round the edifice. The solidity of the Hall is as noticeable as its splendour. The plinth, six feet in height, is formed of large granite blocks from the Haytor quarries, Devonshire; whilst the walls are built of Portland stone. Some of the single blocks used in the shafts of the columns, and in the entablature, weigh as much as twelve tons. The roof is covered with lead.

Within, we enter first into a low square vestibule, where sits the porter in his old-fashioned high circular chair; a place which, though handsome, is unpretending, and enhances by contrast the lofty staircase partially seen through the glazed screen opposite. As we pass through the screen we find ourselves in a scene of true architectural splendour. The broad staircase ascends direct before us, then branches to the right and left to the landing or gallery at the top, which extends along the walls on either side and behind us. Above, at a great height, we look on the richly carved ceiling of the dome, where around a concealed opening in the centre play beams of green and golden light. Pendant from the

* This business is carried on in apartments at the back of the Hall, having a separate entrance.

† And, we may add, the Apothecaries'; these two are the only Companies that retain the old right of control over their respective businesses.



*John Bunyan
1628-1688
The Pilgrim's Progress
1659*

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dome hangs a massive lamp, revealing, when lighted on festive occasions, new beauties in this most beautiful of staircases. Among the other features of the place are the double screens of Corinthian columns with their classic ornaments, Diana and the Hart, and Apollo; the lofty pictures occupying the upper part of the wall before us, comprising portraits of George IV. by Northcote, and George III. and his Queen presented by William IV. from the Palace at Kensington; the bust of William IV. by Chantrey in the niche below; and lastly the sculpture on the four square pedestals which ornament the balustrade of the first flight of stairs. These are four youthful Cupid-like figures typical of the seasons, by Mr. Nixon, two only being yet completed in the marble. The first figure is intently examining a bird's nest, a circumstance suggestive of one of the most interesting of *spring* associations; the second has a wreath of *summer* flowers hanging gracefully round it, and leads a full-grown lamb; the third has its arms filled with goodly sheaves of corn, whilst *autumnal* fruits are wreathed about its body; and the fourth, a charming figure, is confronting the rude *winter* winds, and with difficulty holding close its drapery. Ascending to the gallery, pausing now on the stairs, leaning now over the balcony to admire the beautiful combinations of form which every fresh position commands, we find several doors; one at the top of the staircase on each side opening to the Livery Hall, situated beyond the staircase, and others through rich corridors or passages to a suite of apartments extending along the western front of the building, and over the outer vestibule through which we have passed. And first comes the Court-room on the right of the northernmost corridor. This is an apartment for the meetings of the Court of Assistants, and is handsomely decorated. The stucco ceiling in particular is of very elaborate workmanship; from it hangs a large glass chandelier, now covered up, but the nature of which is made known by the delicate tinkle produced by every passing vehicle. On a sideboard, carefully preserved beneath glass, is one of the most interesting remains we possess of the Romans in London, the little altar-piece engraved in the account of Roman London,* which was dug up during the late rebuilding of the Hall. It has evidently been a fine piece of workmanship, for, although the surface of the stone is greatly corroded, the beauty of the outlines of the figures still arrests the attention at the first glance: the position of the dog may be mentioned as exceedingly expressive and graceful. On the walls hang some interesting pictures. Here is Janssen's rich and beautiful portrait of Sir Hugh Middleton, with a shell in his left hand, typical of the great work of his life, the bringing the springs of Hertfordshire to London. The share that the unfortunate Sir Hugh presented to the Goldsmiths' Company, of which he was a member, is now worth, we believe, between 200*l.* and 300*l.* annually. Another portrait we may mention is that of Sir Thomas Vyner, Knight and Baronet, 1666, the gentleman referred to in the following title of one of the printed accounts of the annual Lord Mayor's pageants. We must premise that the Goldsmiths still make it a matter of etiquette to keep up some of the old state and ceremony on these occasions, which, but for them, would lose half the splendour that yet remains to them. They have, indeed, a very ancient reputation in matters of the kind. When Henry VI.

* Vol. i. p. 291.

expected the coming of the Queen Margaret of Anjou from France, he wrote to the Goldsmiths, as a craft which had at all such times "notably acquitted them," to prepare themselves to do her honour. And the splendour of their appearance at the appointed time showed how they appreciated the application. The title in question runs thus: 'The Goldsmiths' Jubilee; or, London's Triumphs, containing a description of the several pageants; on which are represented emblematical figures, artful pieces of architecture, and rural drawings, with the speeches spoken in each pageant. Performed October 29, 1674, for the entertainment of the right honourable and truly noble pattern of prudence and loyalty, Sir Robert Vyner, Knt. and Bart., Lord Mayor of the City of London, at the proper costs and charges of the Worshipful Company of Goldsmiths. The King's most sacred Majesty and his Royal Consort, their Royal Highnesses the Duke and Duchess of York, Prince Rupert, the Duke of Monmouth, several foreign ambassadors, chief nobility, and Secretaries of State, honouring the City with their presence. Composed by Thomas Jordan.' The procession and pageant together seem certainly to have been a handsome affair. We can only notice the last, which consisted of two parts, the one illustrating, in an ingenious manner, the Company's arms, the other its trade and history. The first pageant consisted of "a large triumphant chariot of gold, richly set with divers inestimable and various-coloured jewels, of dazzling splendour, adorned with sundry curious figures, fictitious stories, and delightful landscapes." In this is "an ascent of seats up to a throne, whereon a person of majestic aspect sitteth, the representer of justice, hieroglyphically attired in a long red robe, and on it a golden mantle fringed with silver; on her head long dishevelled hair of flaxen colour, curiously curled, on which is a coronet of silver; in her left hand she advanceth a touchstone (the tryer of truth and discoverer of falsehood); in her right hand she holdeth up a golden balance, with silver scales equi-ponderent, to weigh justly and impartially; her arms dependent on the heads of two leopards, which emblematically intimate courage and constancy: this chariot is drawn by two golden unicorns, in excellent carving work, with equal magnitude to the life, on whose backs are mounted two beautiful raven-black negroes, attired according to the dress of India; on their heads wreaths of diverse-coloured feathers; in their right hands they hold golden cups; in their left hands two displayed banners, the one of the King's, the other of the Company's, arms. All which represent the crest and the supporters of the ancient, famous, and worshipful Company of Goldsmiths." Of the Trade Pageant Thomas Jordan writes—"On a very large pageant is a rich seat of state, containing the representer of the patron to the Goldsmiths' Company, St. Dunstan, attired in a dress properly expressing his prelatical dignity, in a robe of fine white lawn, over which he weareth a cope or vest of costly bright cloth of gold down to the ground; on his reverend grey head a golden mitre, set with topaz, ruby, emerald, amethyst, and sapphire; in his left hand he holdeth a golden crozier, and in his right hand he useth a pair of goldsmith's tongs. Beneath these steps of ascension to his chair, in opposition to St. Dunstan, is properly painted a goldsmith's forge and furnace, with fire and gold in it, a workman blowing with the bellows. On his right and left hand there is a large press of gold and silver plate, representing a shop of trade; and further in front are several artificers at work on anvils with



PORTRAIT OF DUNSTAN IN FULL ARCHIEPISCOPAL COSTUME. From an Illumination in the Cottonian MS. Claud. A. III,

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hammers, beating out plate fit for the forgery and formation of several vessels in gold and silver. There are likewise in the shop divers wedges or ingots of gold and silver. And a step below St. Dunstan sitteth an assay-master, with his class frame and balance, for trial of gold and silver according to the standard. In another place there is also disgrossing, drawing, and flatting of gold and silver wire. There are also finers melting, smelting, fining, and parting gold and silver both by fire and water. And in a march before this orfery* are divers miners, in canvas breeches and waistcoats, and red caps, bearing spades, pickaxes, twi-bills, and crows, for to sink shafts and make adits.† The devil also appearing to St. Dunstan is caught by the nose at a proper Qu (cue), which is given in his speech. When the speech is spoken the great anvil is set forth, with a silversmith holding on it a plate of massive silver, and three other workmen at work, keeping excellent time in their orderly strokes upon the anvil." Pageants of this character had meaning in them, and must have had at least one beneficial effect, that of making the handicraft arts interesting and their pursuit honourable: we wish we could say as much of the civic pageants of the present day. The connection of St. Dunstan with the Goldsmiths' Company is a curious subject, and one that meets you at every step in their history, as well as in still more palpable shapes in their Hall. Here, for instance, in the Court Room is a large painting, said to be by Julio Romano, but we should think incorrectly, devoted to the Saint's glory. In the foreground appears St. Dunstan, a large figure in a rich robe, and crozier in hand; in the background, by an amusing licence, we see him again, performing his memorable deed of taking the devil by the nose; and above appears the heavenly host, no doubt applauding the deed, and apparently signifying as much to the St. Dunstan in the front of the picture. Then, in the records of the Hall we read of St. Dunstan's almsmen; of St. Dunstan's feast on St. Dunstan's day; of St. Dunstan's eve; of splendid tapestry, made at a great expense in Flanders in illustration of St. Dunstan's exploits, and used for the decoration of the Hall; ‡ of St. Dunstan's statue, in silver gilt, set with gems, which formerly surmounted the screen of the Livery Hall, and which was broken up at the period of the war against images during the Reformation, and turned to the "most profit of the house;" of St. Dunstan's cup, in which the goldsmiths frequently drank to his memory; of "St. Dunstan's light" in St. John's Zachary Church; and of the chapel of St. Dunstan, with another image, in St. Paul's Cathedral. The origin of this connection is no doubt to be found in the circumstance that, when Dunstan left the court of Athelstan in disgust and retired to Glastonbury, he employed himself occasionally in the formation of articles useful to the church, as crosses and censers. Ecclesiastics were then among the most skilful of artificers, for Edgar had directed

* From the French, "Orfèvrerie," we presume, expressive of the goldsmith's art and ware.

† Modes of communication.

‡ The account of "Money delivered to Mr. Gerard Hughes for the rich arras for the hanging of the Hall," the tapestry in question, contains some interesting items: we extract the following. It appears there was "Paid for the devising of the story, for the exchange making of the money, and for costs and charges of Mr. Hughes's servant lying there (in Flanders), and for the canvas, &c., 29*l.* 8*s.* 8*d.*" Then in the "charges for making of the stories in white and black," there was paid to "four masters, every of them for sixteen days," at a shilling a-day, 3*l.* 4*s.* A boy was paid to "sharp their colours," that is, point the chalk or charcoal with which they sketched, 2*d.* a-day; "the translating of the story out of English into Dutch," to enable the foreign workmen to understand it, cost 10*s.* The entire expense of the work was about 550*l.*

that priests, in order "to increase knowledge, should diligently learn some handicraft." And it was whilst Dunstan was thus employed that the devil, having, unfortunately for himself, tempted him once too often, was seized in the unpleasant manner already described. The holy man immediately became famous. The goldsmiths in particular, who seem to have looked on him as one of their craft, now, or soon after, adopted him as their founder and patron saint. We may here add that, in the list of jewellery belonging to Edward I., mention is made of a gold ring, with a sapphire, "of the workmanship of St. Dunstan." The business transacted in the Court Room is, of course, the ordinary business of the Company, as the management of estates, charities,* &c., and presenting, therefore, no interesting features. But it was not so once, when rebellious apprentices had to be whipped or otherwise punished, when offending members had to be reprimanded, sometimes kneeling before the assembled officers, or when the table was covered with goodly collections of gold and silver articles, and sometimes even "pieces of napery" and "cloths of gold," brought as *pledges* to the Company, who seem to have occasionally dabbled in the pawnbroking trade from a very early period. One of the entries on this subject, given in Mr. Herbert's valuable work on the Livery Companies of London, refers to the year 1386. Besides their ordinary duties, the Wardens were occasionally called in to decide matters of a less official nature between the different members of the Company, but where their knowledge or position were found useful. A great deal of jealousy existed at all times between the foreign and English goldsmiths, which sometimes led to serious disputes. A difference of a more friendly nature was that brought before the Wardens in the reign of Edward IV., when two workmen, Oliver Davy, citizen and goldsmith of London, and "White Johnson, Alicant stranger, goldsmith," of the same city, contended for the palm of superiority in the "cunning workmanship" of their craft. The honour of the respective countries was concerned in the struggle, and a high tribunal alone was thought worthy of giving a decision. So at a meeting at the Pope's Head in Lombard Street, in the presence of several distinguished members of the Goldsmiths' Company, the following arrangement, after due consideration, was made. First, that Oliver Davy should "make, work, and grave inward, by the hands of an Englishman, or 'prentice English, in four puncheons of steel, in the breadth of a penny sterling, a cat's face outward embossed in one of the said puncheons, and the same cat's face to be graven inward in another of the same puncheons, and a naked man outward embossed in the third puncheon, and a naked man inward to be graven on the fourth puncheon." White Johnson was to do exactly the same thing by the hands of an Alicant stranger, or Alicant's child, taking his liberty of what nation he would within the city of London, town of Westminster, or borough of Southwark. It was further agreed that the Wardens of Goldsmiths' Hall should decide between them, taking with them, to ensure impartiality, three English and three Alicant goldsmiths. The loser in the struggle was to pay the winner a crown, his costs for making his puncheons, and provide a dinner at the Hall for the

* The property of the Company and the estates it holds in trust for charitable purposes are matters not allowed to come before the public. The Company itself, we may here observe, consists of a master (the office is now held by the Sovereign), a prime and three other wardens, 21 assistants, and 150 liverymen. The chief officer is the clerk, whose position is generally considered to be highly lucrative and influential.

Wardens and for all parties concerned. "And whereas Oliver Davy brought into the Goldsmiths' Hall at his day, as is before limited by the said wager, four puncheons, in breadth of a penny sterling, . . . made by the hands of Thomas Cotterell, the apprentice of the said Oliver, and the said White Johnson brought, by the space of six weeks after that, contrary to his wager, but two puncheons, one of a cat's face graven inward, and another with a naked man graven inward, of a more breadth than his wager, made by the hands of little Court Dutchman, dwelling in the borough of Southwark," the wager is adjudged to be won by Oliver Davy. We do not see how, to use Mr. Herbert's phrase, the "honour of England" was advanced by the decision, as no opinion whatever seems to have been expressed as to the real merits of the respective works. Very proud, however, do the English goldsmiths appear to have been of the result, for when, after having kept the whole six puncheons five years, Oliver Davy brought them into the Goldsmiths' Hall, at the instance of the Wardens, and gave them to the Company, the former, with great solemnity, ordered them "to be laid in the chest with six keys, to that intent that they be ready, if any such controversy hereafter fall, to be showed that such traverse hath been determined aforesaid; and that no Wardens hereafter bear them out of the said Hall, but to remain perpetually in the said place for the cause aforesaid. And that this present writing be laid with the said puncheons in the said chest, that men may understand hereafter the cause of the making of the said puncheons." We may here add that the foreign goldsmiths had at an early period a quarter to themselves, and were regulated by members of their own nation, under the control, however, of the English company, to whose funds they contributed in the shape of fees for apprentices, for admission into the craft, and for licences, also for fines, just the same as the other goldsmiths of London. We have an interesting glimpse of the customs among the artificers in the fifteenth century in one of two documents presented by the German and Dutch goldsmiths to the Wardens of the Company in 1444 and 1452. The last consists of the "Information given to the Wardens by the Dutchmen Goldsmiths enfranchised in the City of London," and states that "the rule in their quarter of goldsmiths is such that there shall no man come to no good city nor town, but he shall be known from whence he cometh, for to occupy the craft of goldsmiths, and that he be true born, and not defective proved. And at his coming in he must put him in service with a master of the said craft. And if he will continue and dwell there a certain time for to set up a house or a shop of the said craft, he must present himself, or else the master that he dwelleth with must present him, to the masters of the craft to set the rule upon him how long space and time it shall be ere he take house or shop of the said craft, at the discretion of the masters, some more, some less, as they find him able, and well named, and of good bearing."

Before quitting the Court Room we must not forget to mention the white marble chimney-piece which was brought from Cannons, the former seat of the Duke of Somerset. The lateral supports consist of two very large and boldly sculptured terminal busts, attributed, we are told, to Roubiliac by a late eminent sculptor.

Leaving the Court Room, and crossing the corridor or passage, we enter the Drawing-room, a scene of almost unsurpassable luxury and splendour. Immense

mirrors cover a considerable portion of the walls, and the remainder, in panels, is hung with crimson satin bordered by white and gold mouldings; the white stucco ceiling is exquisitely wrought with an interminable profusion of flowers, fruits, birds, beasts, and scroll-work ornaments, relieved at the corners of the room by the gay colours of the coats of arms; the soft thick carpet, of a rich maroon ground, presents in the centre the Goldsmiths' arms in all the splendid and proper colours of their heraldic emblazonry, and is as splendidly bordered; the curtains are of crimson damask, gold-embroidered; the chairs and ottomans are covered with crimson satin and gold, the tables are of gold and the most beautiful marbles, and the chimney-piece and grate of an exceedingly sumptuous kind. Add to these features the chandelier hanging from the roof, with its thousand glittering pendants; imagine it lighted, and colours more varied and brilliant than rainbow ever presented shifting and glancing to and fro; behold the room itself thronged with fair and magnificently dressed ladies, their costume only the more impressive from the contrast with the sober dresses of the gentlemen;—and you have altogether as superb a scene of the kind as, with few exceptions, the social life of England could afford.

The chief object of interest in the Court Dining-room, the next of the suite, is the chimney-piece, where in the centre two boys hold a wreath enclosing a head, whose melancholy history is told in the thin, almost attenuated-looking features and sad expression. It is Richard II., the monarch from whom the Goldsmiths' Company may be said to have received their principal charter of incorporation; we say principal, for in all the Goldsmiths received from the time of Edward III. to Elizabeth no fewer than fifteen charters—some of confirmation only, which the Companies of an early day were accustomed to get from time to time, in order to refresh the memory of any monarch who might otherwise be suddenly requiring a very heavy fine,—and others granting new privileges. And we may here fitly pause awhile to notice the early history of this Company. The goldsmith's is perhaps, above all other manual arts requiring any considerable taste and skill, the one in which the English have excelled from a very early period. About 628 Bishop Wilfred built a church at Ripon, in Yorkshire, the columns and porticoes of which were enriched with gold, silver, and purple; and a sumptuous copy of the Gospels, in a case of pure gold set with gems, was among the donations then made. In the Ashmolean Museum a piece of ornamental workmanship in gold that was made for Alfred the Great is still preserved, and the workmanship is of a high order, though the design is rude enough. Again, among the plunder of the Conquest taken over to Normandy by William, on his first visit to his native country after the great event which has made his name so memorable, were a variety of articles, such as golden vases, chased cups of gold and silver, Saxon drinking-cups made of large buffalo-horns, and ornamented at the extremity, which filled the people of that country with astonishment, and shows how far before their conquerors were the Saxons of that day in the goldsmith's craft. William of Poictevin, whose whole account shows what a strong impression the wealth of England had made upon him, speaks expressly of the men excelling in every species of elegant workmanship. A still stronger proof perhaps is to be found in the admiration elicited from Pope Adrian (our countryman) when Robert, Abbot of St. Alban's, sent to him two golden candlesticks:

the Pontiff declared he had never seen more beautiful workmanship. Matthew Paris also describes a large cup of gold made by Baldwin, a goldsmith, for the same Abbot Robert, "which was adorned with flowers and foliages of the most delicate workmanship, and set round with precious stones in the most elegant manner." The service of the churches must have contributed greatly to call forth and to encourage talent of this kind; for, besides the numerous utensils required, there were the gorgeous shrines to decorate and enrich, labours on which immense quantities of the precious metals were lavished during the middle ages.

With the firm consolidation of the kingdom that took place on the cessation of those civil wars, which, owing their origin to the state of things produced by the Conquest, were only ended in 1265 by the fall of De Montfort, and the consequent increase of the general prosperity, the monarchs no doubt became more luxurious and expensive. The wardrobe account of Edward I.'s plate and jewels is exceedingly curious, and illustrates in various points the manners and customs of the age, as well as the state of the goldsmith's art. Ade was the King's artificer, no doubt the chief goldsmith of his day. The list comprises thirty-four pitchers of gold and silver, ten gold cups, ten cups of silver (gilt and plain, some having stands, and enamelled), and above one hundred other cups of silver; also a pair of knives with silver sheaths, enamelled, with a *fork* of crystal; a pair of knives with ebony and ivory handles and studs, a large ewer set all over with pearls, a comb and looking-glass of silver gilt, enamelled, and a silver bodkin in a leathern case; gold, silver, and crystal crosses, some set with sapphires, and enclosing relics, and one with emeralds and other precious stones, enclosing a great piece of the real cross of Christ; pikes of gold and silver, shrines, silver trumpets, gold clasps, rings, a large silver girdle ornamented with precious stones; a large image of the King in silver, habited in a surcoat, and with a hood over his head and a silver plate under his feet; and five serpent tongues in a standard of silver. Lastly, there are four royal crowns, one set with rubies, emeralds, and great pearls; another with rubies and emeralds; another with Indian pearls; and a fourth, a great crown of gold, with emeralds, sapphires of the east, rubies, and large eastern pearls—this was the coronation crown. Among this splendid collection was the "gold ring with a sapphire" before mentioned, which, we are told, was of the workmanship of St. Dunstan. A body of men, comprising among their members skill to accomplish works of the kind here indicated, and who, from the very value of the materials on which they worked, must have been persons of character and consideration, were not likely to be the last to seek the protection of the Guild, or general association of those engaged in their pursuit; indeed, if we had the means of knowing the early history of these associations, we should probably find the goldsmiths were among the first, if not the very first, to defend themselves, their properties, and their personal freedom in this manner. Not that we are to look upon the artificers of that period as so many peaceful citizens, who were nothing except when banded together. Not a man of them but knew how to defend himself, if he were attacked, by the skilful use of his own trusty weapon: a circumstance that made the members of the chief trades, when in union, truly formidable bodies. This is illustrated in an incident that has been preserved of a quarrel between the goldsmiths and the merchant tai-

lors about the middle of the thirteenth century, when their animosity proceeded so far that they, and their respective friends, met by mutual consent one night, to the number each of five hundred men completely armed, and commenced a regular battle, which was so fiercely maintained that, before the Sheriffs could succeed in bringing a great body of the citizens to put a stop to the proceedings, several were killed and many wounded on both sides. The combatants suffered severely, in the whole, for their display of martial valour—thirteen of the ringleaders perishing on the scaffold. The earliest mention of the goldsmiths as a guild occurs in the beginning of the century marked by this combat, when Henry II. fined the adulterine or unlicensed guilds; and among those who were the most heavily mulcted were the goldsmiths. From this time to the reign of Edward III. we find nothing particularly deserving notice in the history of the Guild, but in that reign they began to bestir themselves to acquire a new and more commanding position. The petition presented to Edward and his Council in Parliament, in the first year of his reign, gives us an interesting glimpse of the state of the trade at that time in London. In this petition they show “that no private merchant nor stranger heretofore were wont to bring into this land any money coined, but plate of silver to exchange for our coin. And that it had been also ordained, that all who were of the goldsmith’s trade were to sit in their shops in the high street of Cheap; and that no silver in plate, nor vessel of gold or silver, ought to be sold in the city of London, except at or in the Exchange, or in Cheapside among the goldsmiths, and that publicly, to the end that the people of the said trade might inform themselves whether the seller came lawfully by such vessel or not. But that now of late the said merchants, as well private as strangers, brought from foreign countries into this nation counterfeit sterling, whereof the pound was not worth above sixteen sols of the right sterling; and of this money none could know the true value but by melting it down. And also that many of the said trade of goldsmiths kept shops in obscure turnings and bye-lanes and streets, and did buy vessels of gold and silver secretly, without inquiring whether such vessel were stolen or lawfully come by; and, immediately melting it down, did make it into plate, and sell it to merchants trading beyond sea, that it might be exported. And so they made false work of gold and silver, as bracelets, lockets, rings, and other jewels; in which they set glass of divers colours, counterfeiting right stones, and put more alloy in the silver than they ought, which they sold to such as had no skill in such things.” They add, also, that “the cutlers, in their work-houses, covered tin with silver so subtilly, and with such sleight, that the same could not be discerned and severed from the tin; and by that means they sold the tin so covered for fine silver, to the great damage and deceit of the King and his people.” The answer to this petition was very satisfactory, granting to the goldsmiths, apparently, everything they desired. Merchants were no longer to bring any sort of money from abroad, but only plate of fine silver; goldsmiths were prohibited from selling gold or silver, wrought, or plate of silver, to any such merchants to be carried out of the kingdom; “none that pretended to be of the same trade should keep any shops but in Cheapside, that it might be seen that their works were good and right;” and lastly,—and this was the most important concession of the whole,—those of the same trade might elect honest, lawful, and sufficient men, best skilled in the said trade, to inquire of the mat-

ters aforesaid, to reform defects, and inflict due punishment upon offenders. In this, the first charter, the Company are addressed as the King's "beloved, the Goldsmiths of London:" nor was the charter in question all the evidences of his love; he subsequently empowered them to purchase estates to the value of 20*l.* yearly for the support of decayed members: a gift of ten marks, it must be observed, had something to do with all this beneficence. In the reign of Richard II. the Company became, as before stated, essentially, though still not nominally, incorporated, as "a perpetual community," with "liberty to elect yearly for ever four wardens, to oversee, rule, and govern the said craft and community." Subsequent monarchs from time to time confirmed and enlarged their privileges, till Edward IV. in express words ordained them a "corporation, or body incorporate, by the name of Wardens of the Mystery of Goldsmiths of the City of London," and gave them the power of inspecting, trying, or regulating all gold and silver works throughout the kingdom. Lastly, we may observe that, being opposed in their trade search and assay, during the reign of Henry VII., that monarch gave them additional power to imprison or fine defaulters, to seize and break unlawful work, to compel the trade within three miles of the City to bring their work to the Company's common-hall to be assayed and stamped, and in case it was not standard to utterly condemn the same. The searches referred to must have led to some curious scenes. The trade was divided among foreigners and natives, whose chief places of resort at first were Cheapside and the immediate neighbourhood of the Goldsmiths' Hall, but who by the time of Henry VIII. had extended their shops to different parts of London and Westminster. The Sanctuaries were very naturally the resort of numbers of the dishonest portion of the trade; and in the Goldsmiths' books, under the date of 20 Henry VI., we find a not unamusing instance in point:—"Also it is to remember that the 20th day of April, the year of King Henry above written, the said Wardens went to Saint Bartholomew's, and there they spake with the Prior of the same place, of such untrue workers that were inhabiting in the same place, the which the Prior knew not. And while the Wardens and the Prior stood together came one John Tomkins, that was sometime a good workman of goldsmiths' craft. And there the Prior commanded him to go with him and with the Wardens, for to bring him to his chamber. And when they came there, he would not let them in. And the Prior made him to deliver his key to him. And then they went in; and there they found divers bandis of latten, the which to let in goblets forthwith. And also there was found a piece in the bed straw, the which was copper, and silver above; the which was likely for to have been sold for good silver. And while it was a-doing the said false varlet stole away out of the place, or else he had been set in the stocks." Besides general quarterly searches, we find the Wardens were always on the watch on the occasion of any unusual assemblage of persons likely to buy trinkets, and more particularly during fairs. Like some of the similar searchers of the present day with regard to weights, due warning was given to delinquents to hide whatever they chose. In reading the account of the array of the search, one sees very plainly that the worst rogues must have escaped amidst so much ceremony. First came the beadle with his insignia of office, and in full costume; then the wardens in their hoods and livery, the Company's clerk, two reuter wardens, two brokers,

with porters and other attendants properly habited. These on "St. Bartholomew's Eve went all along Cheap, for to see what plate is in every man's desk and girdle;" then into Lombard Street. And on the following day they went through the fair "to see every hardware-man's show, for deceitful things, beads, gauds of beads, and other stuff; and then," adds the 'Manner and Order of Proceeding' from which we quote, "they are to drink, when they have done, where they please." The legislature had at different periods endeavoured to assist the searchers in the attainment of the common object, honest trade, by various regulations. In 1403 an act was passed, stating that, "whereas many fraudulent artificers, imagining to deceive the common people, do daily make lockets, rings, beads, candlesticks, harness for girdles, hilts, chalices, and sword-pommels, powder-boxes, and covers for cups, of copper and latten, like to gold and silver, and the same sell and put in gage to many men not having full knowledge thereof for whole gold and silver," in future no such articles shall be gilt or silvered, whether with or without intention to deceive, under a penalty of 100%. The only exceptions were articles for the use of the Church, most of which might be made of silvered copper or latten, "so that always in the foot, or some other part, of every such ornament so to be made, the copper and the latten shall be plain, to the intent that a man may see whereof the thing is made, for to eschew the deceit aforesaid." A curious and at the same time frightful incident of an earlier time is mentioned in Arnold's 'Chronicle,' where "all the goldsmiths of London" themselves are stated to have been the delinquents. In 1278 these, with "all those that kept the Change, and many other men of the City, were arrested and taken for buying of plates of silver, and for change of great money for small money [we presume, by recoining and giving their own coin for the King's], which were indicted by the wards of the City; and on the Monday next after the Epiphany, the Justices sitting at the Guildhall to make deliverance, that is to say, Sir Stephen of Pencestre, Sir John of Cobham, and other which that these lust (pleased) to associate to them, and there were prejudged and drawn and hanged three English Christian men, and two hundred four score and twelve English Jews!" Such was the wholesale butchery dignified by the name of justice in the thirteenth century.

From the Court Dining-room pass we now through the passage and across the top of the staircase to the Livery Hall, the fitting conclusion of the whole we have beheld. This is a room of great size and noble proportions, measuring about eighty feet in length, forty in width, and thirty-five in height. Noble ranges of scagliola Corinthian columns insulated from the wall, and raised on lofty pedestals, support the roof, which is one dark but most rich mass of ornamental decoration, and from which hang numerous chandeliers. Five lofty windows in the side that faces you as you enter shed a rich light through the place, being more than half filled with armorial bearings; and the remainder of the unoccupied space is marked off into small square compartments of ground glass, which alone give a fine effect to the windows whilst excluding a bad view. A screen, and gallery above, ornament the one extremity, and a niche for the display of the Company's plate the other. This niche is an elegant contrivance. The back is lined with plain scarlet drapery, and in the centre is a wooden framework similarly covered, which, with the assistance of the light admitted from



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above, displays the treasures of the Company in a pyramidal form with the happiest effect. Many of the separate articles of that pyramid have a history of themselves; we can only mention one of them:—the cup. This is by no less an artist than Cellini, and was presented by Queen Elizabeth (who Pennant observes was “particularly kind to the citizens, and borrowed money of them on all occasions”) to Sir Martin Bowes, whilst he was Lord Mayor, by whom it was presented to his brethren the Goldsmiths, with a charge to drink his health at certain periods in it, and to have a good dinner afterwards: we believe we are not hazarding too much to say that neither of these debts of gratitude are neglected. On each side of the niche is a mirror of unusual size, with busts in front, at their base, of George III. and George IV. Between the scagliola pillars, adorning the side opposite to the window, are lofty portraits, kingly or queenly subjects as usual (the loyalty, and church-and-state pride of the Goldsmiths' Company are well known); comprising portraits of Queen Adelaide by Sir Martin Archer Shee, William IV. in the appropriate costume of a “Sailor King,” and her present Majesty, by Sir George Hayter. In looking again at the richly stained arms which Mr. Willement has placed in the windows, consisting of the arms of the twenty-five Members of the Court of Assistants, at the period of the opening of the Hall in 1835, and of other assistants who have since died, a suggestion occurs which we think deserves consideration. In the annals of the Company, many are the worthies whose life and character must have an interest for the members; surely their arms should be here. There is Gregory de Rokelsey, for instance, goldsmith, who was eight times Lord Mayor of London, keeper of the King's Exchange, and chief Assay Master of all the English Mints. And if these recommendations are not sufficient, there is one better still. This is the man whom honest Stow praises for having refused to compromise the dignity of his office, by answering as mayor a mandate to attend the King's Justices in the Tower, but who showed his individual respect for it by throwing off his civic robes at the Church of Allhallows, Barking, and then obeying the mandate as a private individual. The act led not only to his arrest, but to the arrest of the liberties of the City for a time. Then again there is Sir Nicholas Farindon, who gives name to the Ward of Farringdon, and the various benefactors of the Company, among whom Thomas Wood, sheriff in 1491, should not be forgotten. This gentleman built “the most beautiful frame of fair houses and shops” in Cheapside, which Stow describes as containing in number “ten fair dwelling-houses and fourteen shops, all in one frame, uniformly builded four stories high, beautified towards the street with the Goldsmiths' arms, and the likeness of *woodmen* in memory of his (the builder's) name, riding on monstrous beasts; all which is cast in lead, richly painted over, and gilt: these he gave to the goldsmiths, with stocks of money to be lent to young men having those shops,” &c. These, we presume, were the goldsmiths' stalls which Hall so oddly describes in connexion with the pageants on the occasion of the marriage of Henry VIII. with his first wife, as “being replenished with virgins in white with branches of white wax.” Numerous other members of still greater general reputation will readily occur: it will suffice to mention the admirable Sir Hugh Middleton, and Sir Francis Child, goldsmith, Lord Mayor, and founder of the first regular banking-house in England, the well-known and highly respectable establishment in Fleet

Street. The chief difficulty that might have been experienced in carrying into effect the plan proposed has been anticipated by the careful Stow; the arms of the oldest member we have here mentioned, Rokesley's, for instance, will be found among the engravings of the 'Survey.'

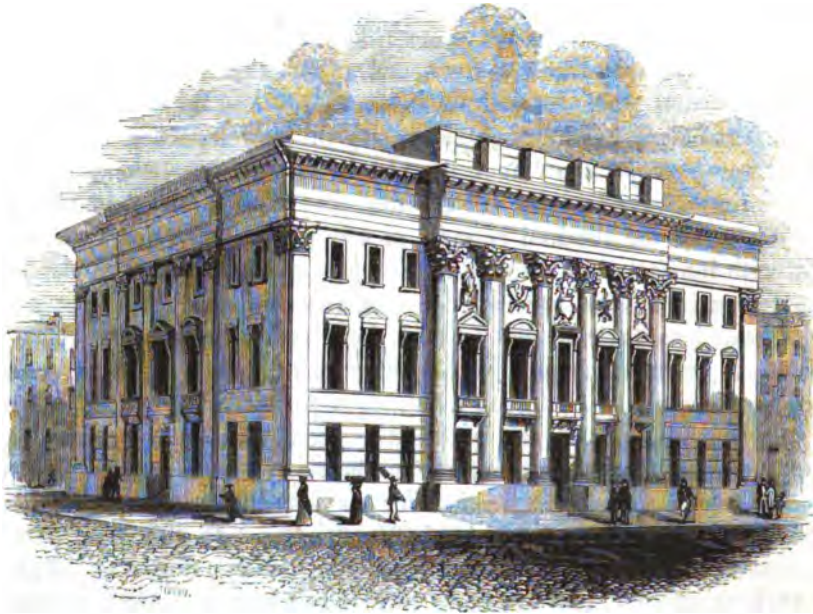
The mention of Sir Francis Child recalls one of the most important circumstances in the history of the Company,—its connection with the origin of the mighty system of modern banking. Our earliest bankers were, as is well known, the Jews; though, as their system seems to have been to receive deposits of goods, or title-deeds, &c., as security, they were perhaps more correctly called pawn-brokers. In the thirteenth century a more respectable class of men, the Lombards, or Italian merchants, then recently settled in England, began to obtain much of this trade. The goldsmiths, we have already seen, were occasionally bankers, in the only sense in which banking as yet existed, so early as 1386, in imitation, probably, of the Lombards. And till the seventeenth century matters remained in this state. At that time a concurrence of peculiar circumstances led them to embark largely in the business. In Anderson's 'History of Commerce' is given a curious account of these circumstances, on the authority of a rare pamphlet of the date of 1676, entitled, 'The Mystery of the new-fashioned Goldsmiths, or Bankers, discovered.' From this publication it appears that the London merchants had been generally accustomed to deposit their money in the Tower, in the care of the Mint Master. A little time before the meeting of the Long Parliament, Charles I. seized there 200,000*l.*, professedly as a loan, of course not only without the consent, but to the extreme indignation, of the unfortunate owners. No more money after that time found its way into the Mint for the sake of security. And then, according to the pamphlet, it became customary with merchants and traders to intrust their cash to their clerks and apprentices: a striking evidence, by the way, of the terrible state of insecurity of men's property before the breaking out of the civil war. When the latter burst like a storm over the whole country, many of these clerks and apprentices took the opportunity of relieving themselves of the dulness of the shop and desk, and their masters at the same time of the superfluous cash they had placed in their hands; and thus a new and better mode of disposing of such money became indispensable. At last, about the year 1645, the merchants began to place their funds in the hands of the Goldsmiths, who now first added this the essential feature of a bank to their ordinary occupations of buying and selling plate and foreign coins of gold and silver, of melting and culling these articles, some to be coined at the Mint, and the rest to be used in supplying the general dealers in the precious metals, jewellers, &c. The wealth and reputation of the Company would at once give confidence in the new mode, and consequently the business transacted increased so greatly in amount as to become a matter of very high importance and consideration. "It happened," says the writer of the pamphlet, "in those times of civil commotion, that the Parliament, out of the plate and from the old coin brought into the Mint, coined seven millions into half-crowns; and there being no mills then in use at the Mint, this new money was of very unequal weight, sometimes twopence and threepence difference in an ounce; and most of it was, it seems, heavier than it ought to have been in proportion to the value in foreign parts." What follows is a sad charge against the respectable Company which has a St.

Dunstan for its founder. "Of this the goldsmiths made, naturally, the advantages usual in such cases, by picking out or culling the heaviest, and melting them down, and exporting them. It happened also that our gold coins were too weighty, and of these also they took the like advantage. Moreover, such merchants' servants as still kept their masters' running cash had fallen into the way of clandestinely lending the same to the goldsmiths at fourpence per cent. per diem (about six per cent. per annum), who by these and such-like means were enabled to lend out great quantities of cash to necessitous merchants and others, weekly or monthly, at high interest; and also began to discount the merchants' bills at the like or an higher rate of interest." It would have been worth while to see the puzzled looks of the merchants when they first found the ingenious use their clerks had made of their money; and the whole affair must have occasionally led to some amusing scenes,—clerks perhaps sometimes discounting themselves instead of through the goldsmiths, and, possibly, their own masters' bills as they circulated in due course of trade, not for their masters, but with their masters' own money; but their impudence may not have ventured quite so far as that. Respecting the goldsmiths as bankers, the pamphlet continues,—“Much about the same time they began to receive the rents of gentlemen's estates remitted to town, and to allow them and others who put cash into their hands some interest for it (the clerks had taught them this, we suppose) if it remained but for a single month in their hands, or even a lesser time. This was a great allurement for people to put their money into their hands, which would bear interest till the day they wanted it. And they could also draw it out by one hundred pounds, or fifty pounds, &c., at a time, as they wanted it, with infinitely less trouble than if they had lent it out on either real or personal security. The consequence was, that it quickly brought a great quantity of cash into their hands, so that the chief or greatest of them were now enabled to supply Cromwell with money in advance on the revenues, as his occasions required, upon great advantages to themselves.” This system continued on the Restoration, the goldsmiths principally confining the lending part of the new business to Government, but borrowing, we presume, from whoever chose to lend. They gave receipts for the sums deposited, which, passing from hand to hand, became a virtual kind of bank-notes. In this brief detail we see in operation nearly all the parts of a modern banker's business. But concerns of such magnitude, and involving principles which, according as they are right or wrong, materially influence to prosperity or distress the entire nation, require all the thought and skill and capital of those concerned in its management. Some of the more intelligent goldsmiths soon perceived this, and also that magnificent fortunes would no doubt be realized by those who, possessing the requisite qualifications, should first devote their exertions solely to it. Francis Child was the first of these persons, and may, therefore, be very properly called the “father of the profession.”* He was originally an apprentice to William Wheeler, goldsmith and banker, whose shop was on the site of the present banking-house. Child married his master's daughter, and thus succeeded to the estate and business. The latter, we presume, from the very circumstance of his being generally acknowledged to be the first regular banker,

* Pennant.

thenceforth, or at least subsequently, confined his business entirely to the banking department. He died in 1713 as *Sir Francis Child*, and after having served the offices of sheriff, lord mayor, and member of parliament for the City.

Having been so recently erected, of course the Hall has, properly speaking, no history, unless the splendid banquet which marked its opening on the 15th of July, 1835, be esteemed such, when the Duke of Wellington, and many other distinguished personages connected with the same political party, were among the guests. There was certainly one feature of that meeting worthy of notice—the declaration of the Prime Warden, who, in stating that the creation of a building-fund had long been in contemplation for the re-erection of their mansion, added, “by means of that fund they had been enabled to complete this great structure without trenching on the charitable funds of the Company: not one pension had been abridged—no charity was diminished—not one single petition for the relief of their poorer brethren was rejected.”



[Goldsmiths' Hall. Exterior View.]

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Gregory de Rokeley, who was eight times Lord Mayor, and who is celebrated in history, at a period when king's mandates were not always in accordance with justice, and when the bearing of the citizens was one of the most important bulwarks of the nascent liberties of the country. Gregory might have been justified in going further than he did; for, whilst he declined to compromise the dignity of the City by appearing before the justices in the Tower as Mayor, he obeyed the mandate in his private capacity. Sir Nicholas Farindon, whose name is preserved in the wards of Farringdon, was a member, as also Sir Francis Child, goldsmith and Lord Mayor, the founder of the first regular banking-house, still carried on next Temple Bar. A still more important member was the originator of the New River Company, Sir Hugh Middleton. He left a share for the benefit of decayed members. This was lately worth between 200*l.* and 300*l.* annually.

We are not able to make any approximate estimate of the income of the Company; it is, no doubt, very great; but we find, from Knight's "London," that the Charity Commissioners set down the annual payments to the poor alone at 2886*l.*

The old building on the present site was not without merit. There is a view, and a notice of it, in Brayley's "London and Middlesex." It was erected soon after the Great Fire, on the site of an earlier building, and surrounded a square paved court, the hall being on the east side. The front—of which the centre part had a slight projection—was of brick with stone quoins, crowned by a cornice with cantilevers; the windows were square, arch-headed, and oval, and there was a mezzanine story. There was a large arched entrance with Roman Doric columns, and broken segmental pediment, with the arms. Internally, the hall was wainscoted in oak, and had a richly-carved screen with composite pillars and pilasters, and a balustrade with vases terminating in branches for lights, between which were the banners used on public occasions; and there was a large buffet with white and gold ornaments. The room had a rich ceiling with large centre flower, and the arms of the City and the Company in various compartments. The staircase had a carved balustrade, and on the walls were *relievs* of scrolls, flowers, and musical instruments. The Court Room was also wainscoted, and the account describes its ceiling as loaded with embellishments. The chimney-piece, brought from Cannons, the former seat of the Duke of Somerset, as it is preserved, will shortly require notice.

The present edifice was designed by Mr. Philip Hardwick, R.A. It was opened with a grand banquet, on July 15th, 1835, soon after its completion, so that it was in progress in or about the same time as the building last noticed, compared with which it has more of the Roman, or rather Palladian character.

With all the talk about the degenerate state of modern architecture, not altogether to be wondered at, and though we could not assert that no meritorious works were produced by the architects of fifteen or twenty years ago, there is nevertheless now-a-days a *tendency* towards sound principles of criticism, which may eventually emancipate us from the confusion of

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THE DOMESTIC MANNERS OF THE ENGLISH.

DURING THE MIDDLE AGES.

BY THOMAS WRIGHT, F.S.A., ETC.

WITH ILLUSTRATIONS BY F. W. FAIRHOLT, F.S.A.

X. OCCUPATIONS OUT OF DOORS.—THE PLEASURE GARDEN—AMUSEMENTS.—HAWKING AND HUNTING.—RIDING—CARRIAGES.—TRAVELLING.—HOSPITALITY.—LEARNING AND STUDIES.

WE begin now to be better acquainted with the out-of-door amusements of our forefathers which were numerous and varied. Among more refined classes, the favourite place of resort was the garden, which during the middle ages appears to have been an object of great care and attention. We trace throughout the mediaeval poetry proofs of a great love of flowers; and maidens and young men are often described passing their times in forming posies or plaiting garlands in the alleys of the gardens. At festivals, the guests were often crowned with garlands of roses and other flowers. The gardens were also diversified with plots of soft grass which they indulged in games, many of which would not be tolerated by modern politeness. But the favourite amusement was the carol dance. In Chaucer's "Frankleyn's Tale," the Lady Dorigen was in want of amusement, and she made her forget the absence of her husband, friends, finding that the sea-shore was sufficiently gay,—

—chope hem for to pleien somwhere elles,
They leden hire by rivers and by welles,
And eke in other places delitable;
They dauncen, and they play at ches and tables.
So on a day, right in the morwe tide,
Unto a garden that was ther beside,
In which that they had made hir ordinance
Of vitails, and of other purveance,
They gon and pleie hem al the longe day:
And this was on the sixte morwe of May;
Which May had painted with his softe schoures
This garden ful of leves and of floures:
And craft of mannes hond so curiously
Arrayed had this garden of suchis pris
As if it were the verray paradis.

And after dinner gan they to daunce
And singe also; sauf Dorigen alone—

An important incident in the story here occurs after which—

The come hir other frendes many on,
And in the alleys romed up and down,
And nothing wist of this conclusoun,
But sodenly began to revel newe,
Til that the brighte sonne had lost his hewe.

It would be easy to multiply such descriptions as the foregoing, but we will only refer to the well-known one at the commencement of the Romance of the Rose, where the carolling is described with more minuteness than usual. There employed minstrels, and "jogelours," and parently even tumblers, which are thus described in Chaucer's English version:—

The mightiest thou karrolls sene,
And folks daunce, and merie ben,
And made many a faire tourning
Upon the grene grasses springing.
There mightist thou se these futours,
Minstralls and eke jogelours,
That well to singin did ther paine.
Some songin songis of Lorraine;
For in Lorraine ther notis be
Ful swete than in this contré.
Ther was many a timbatore,
And allours (*jumpers*, or *tumblers*), that I dar

swere
Yeothe (*meas*) ther craft ful partyt,
The timbris up ful subtilly
Thei castin, and hent them ful oft
Upon a fingir faire and soft,
That that ne fallid never mo.
Ful fetis damocellis two,
Right yong, and ful of semelyhede,
In kirtils and none othir wede,
And faire y-tressed every tressed,
Had Mirthe y-doen for his noblesse
Amide the carole for to daunce.
But hereof leith no remembrance
How that thei dauncid merrily

Hawking was a favourite recreation with the ladies, and in the illuminated manuscripts they often figure in scenes of this kind. Sometimes they are on foot, as in the group represented in our Cut (No. 5), taken from a manuscript in the

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—LINDSAY HAWKING—

one trait of the mixture of Oriental manners with those of Europe which had taken place since the crusades. Many other amusements, besides dancing, were practised by the ladies and young men on these occasions, most of which have since been left to mere children. We find some of these represented in the illuminated margins of old manuscripts, as in the annexed example (from MS. Harl. No. 6563), which



No. 1.—BALL-PLAYING.

represents apparently two ladies playing with a ball. In other instances, a lady and a gentleman are similarly occupied.

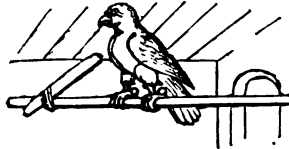
Among the uneducated classes the same rough sports were in vogue that had existed for ages before, and which continued for ages after. Many of these were trials of strength, such as wrestling and throwing weights, with archery, and other exercises of that description; others were of a less civilised character, such as cock-fighting and bear and bull-baiting. These latter were favourite amusements, and there was scarcely a town or village of any magnitude which had not its bull-ring. It was a municipal enactment in all towns and cities that no butcher should be allowed to kill a bull until it had been baited. The bear was an animal in great favour in the middle ages, and was not only used for baiting, but was tamed and taught various performances. I have already, in a former paper, given an example of a dancing bear under the Anglo-Saxons; the accompanying Cut (No. 2), is



No. 2.—A DANCING-BEAR.

another, taken from a manuscript of the beginning of the thirteenth century, in the British Museum (MS. Arundel. No 91).

Hawking and hunting, especially the former, were the favourite recreations of the upper classes. Hawking was considered so honourable an occupation that people were in the custom of carrying the hawk on their fists when they walked or rode out, when they visited or went to public assemblies, and even in church, as a mark of their gentility. In the illuminations we not unfrequently see ladies and gentlemen seated in conversation, bearing their hawks on their hands. There was generally a *perche* in the chamber expressly set aside for the favourite bird, on which he was placed at night, or by day when the other occupations of its possessor rendered it inconvenient to carry it on the hand. Such a *perche*, with the hawk upon it, is represented in our Cut No. 3, taken from a manuscript of the romance of Meliadus, of the fourteenth century (MS. Addit. in the British Museum.



No. 3.—A HAWK ON ITS PERCH.

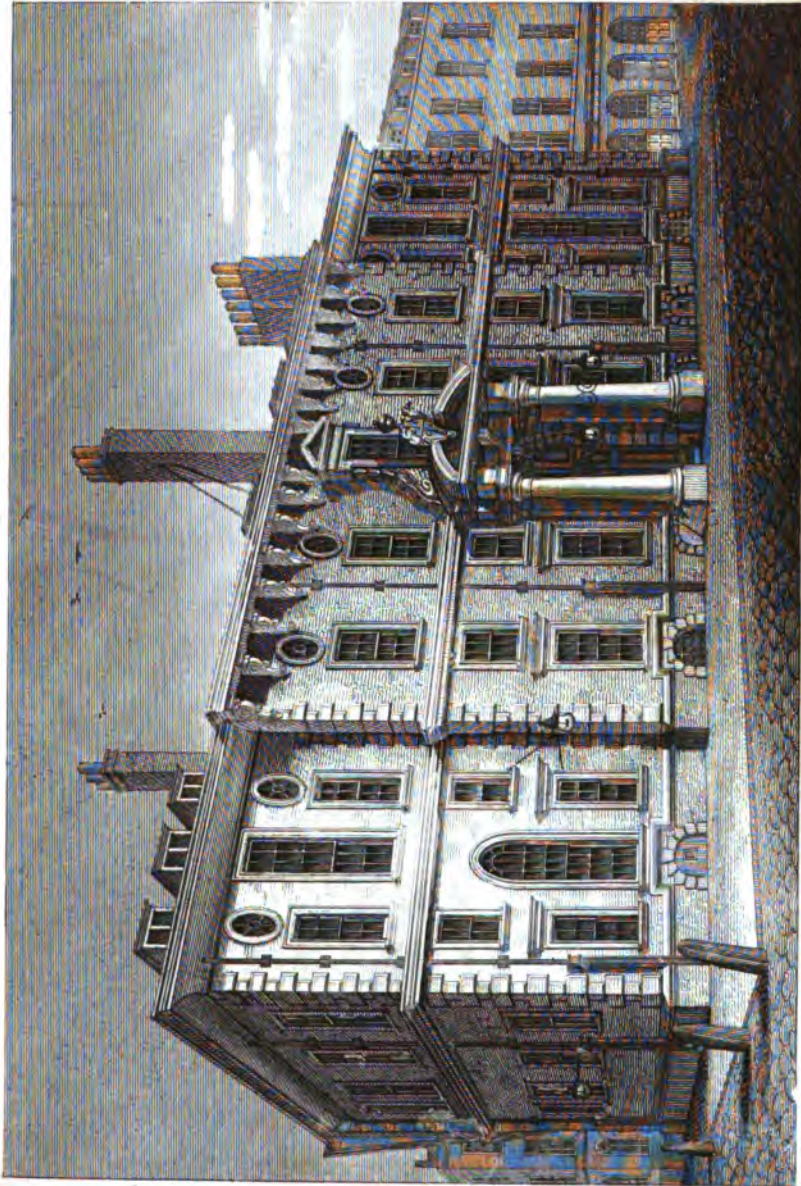
No. 12,224). Hawking was in some respects a complicated science; numerous treatises were written to explain and elucidate it, and it was submitted to strict laws. Much knowledge and skill were shown in choosing the hawks, and in breeding and training them, and the value of a well-chosen and well-trained bird was considerable. When carried about by its master or mistress, the hawk was held to the hand by a strap of leather or silk, called a *jesse*, which was fitted to the legs of the bird and passed between the fingers of the hand. Small bells were also attached to their legs, one on each. The accompanying Cut (No. 4), is from a manuscript in the Bibliothèque Nationale at Paris, (No. 6956)



No. 4.—HAWKS AND THEIR KEEPER.

represents the falconer or keeper of the hawks holding in one hand what appears to be the jesse; he has a bird in his right hand, while another is



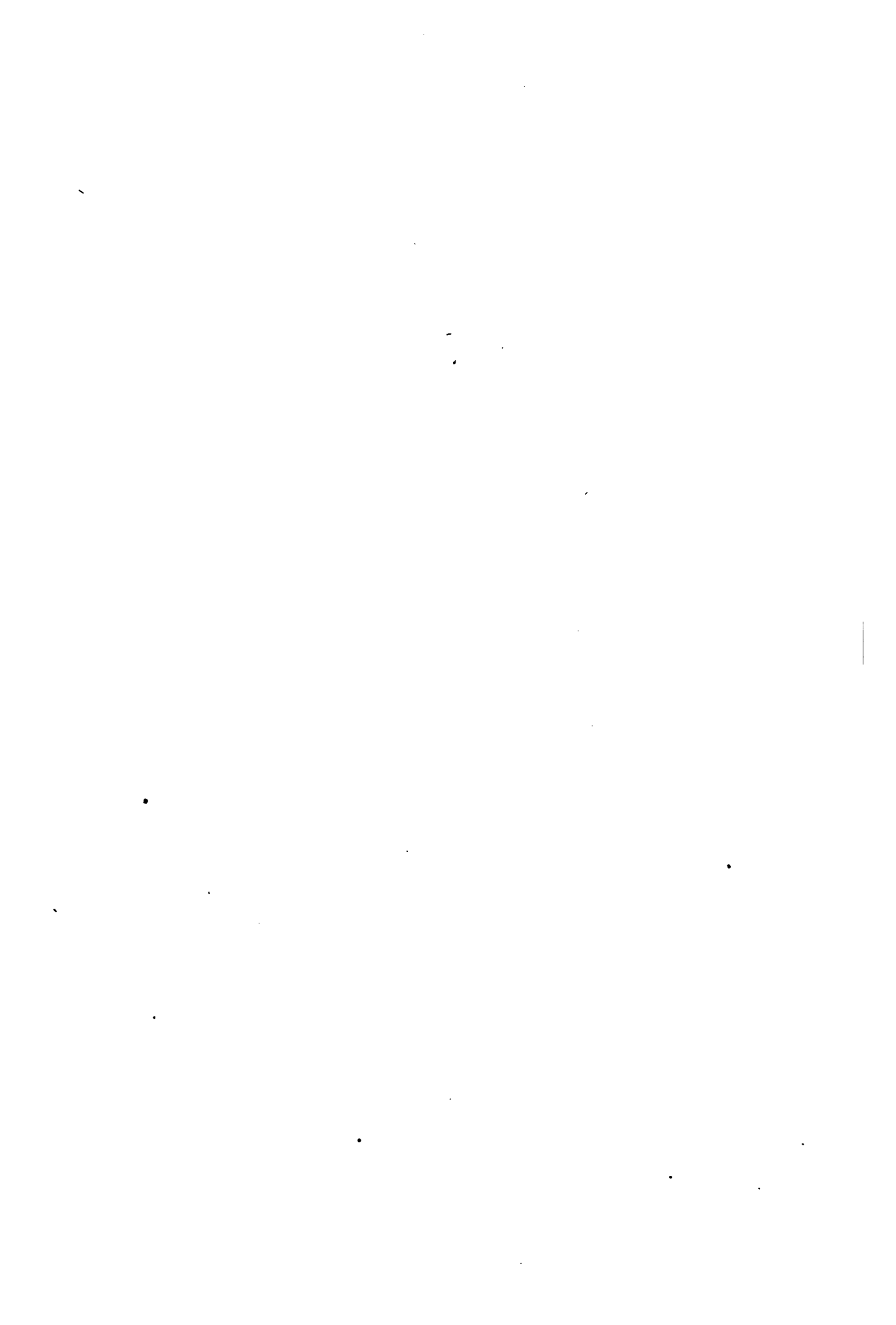


GOLDSMITHS HALL.

Engraved by James Heath & Sons, Printers, New York.

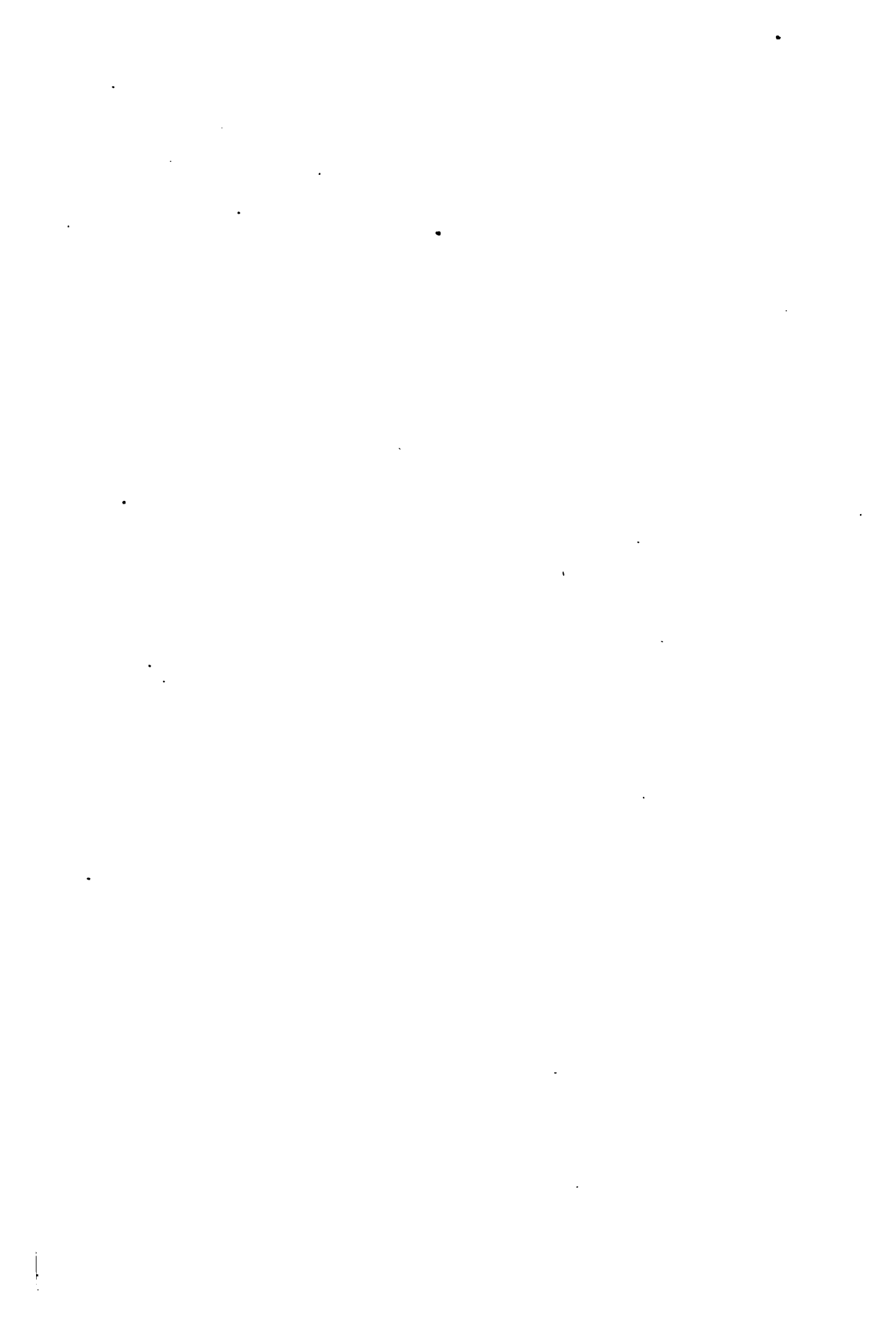
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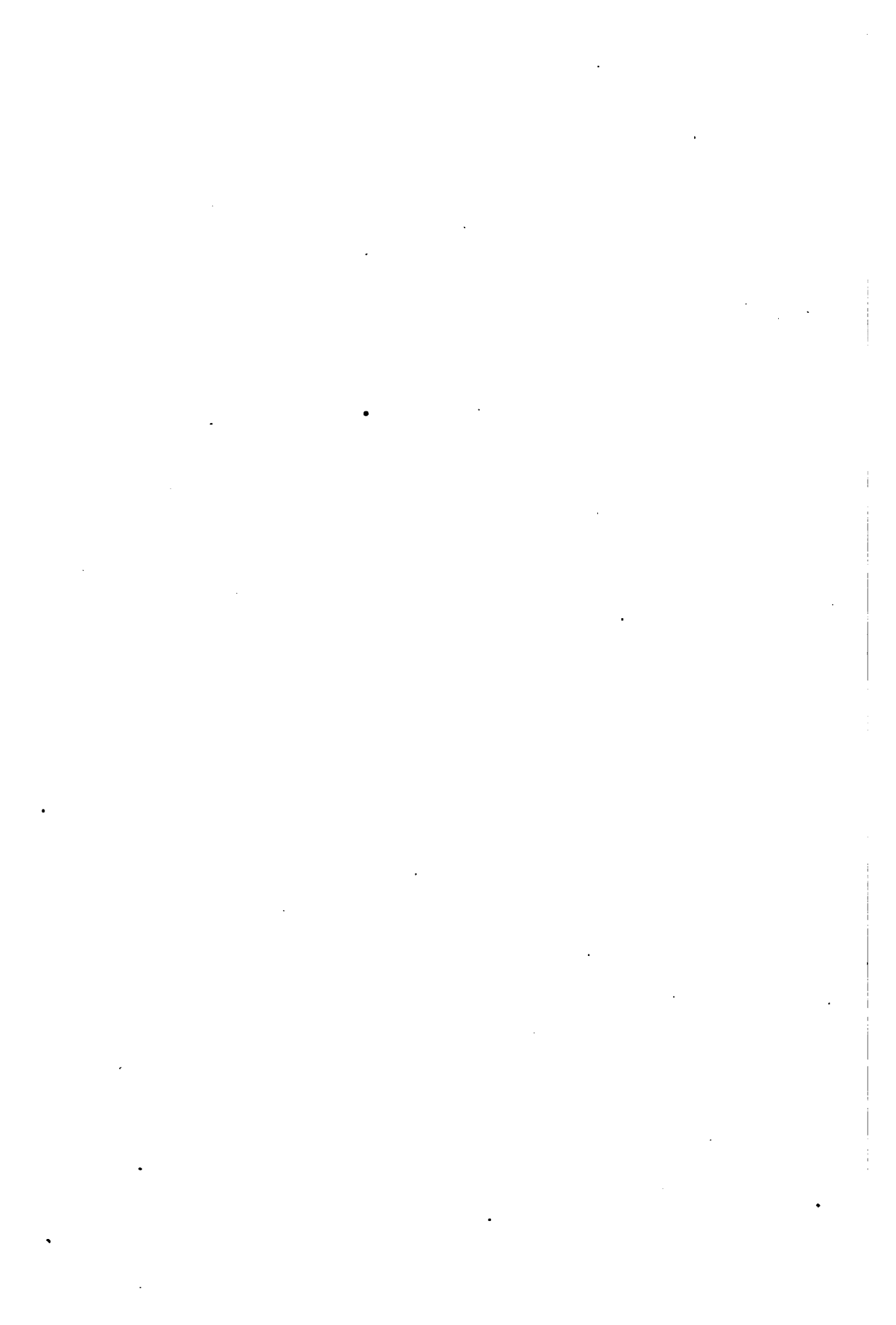


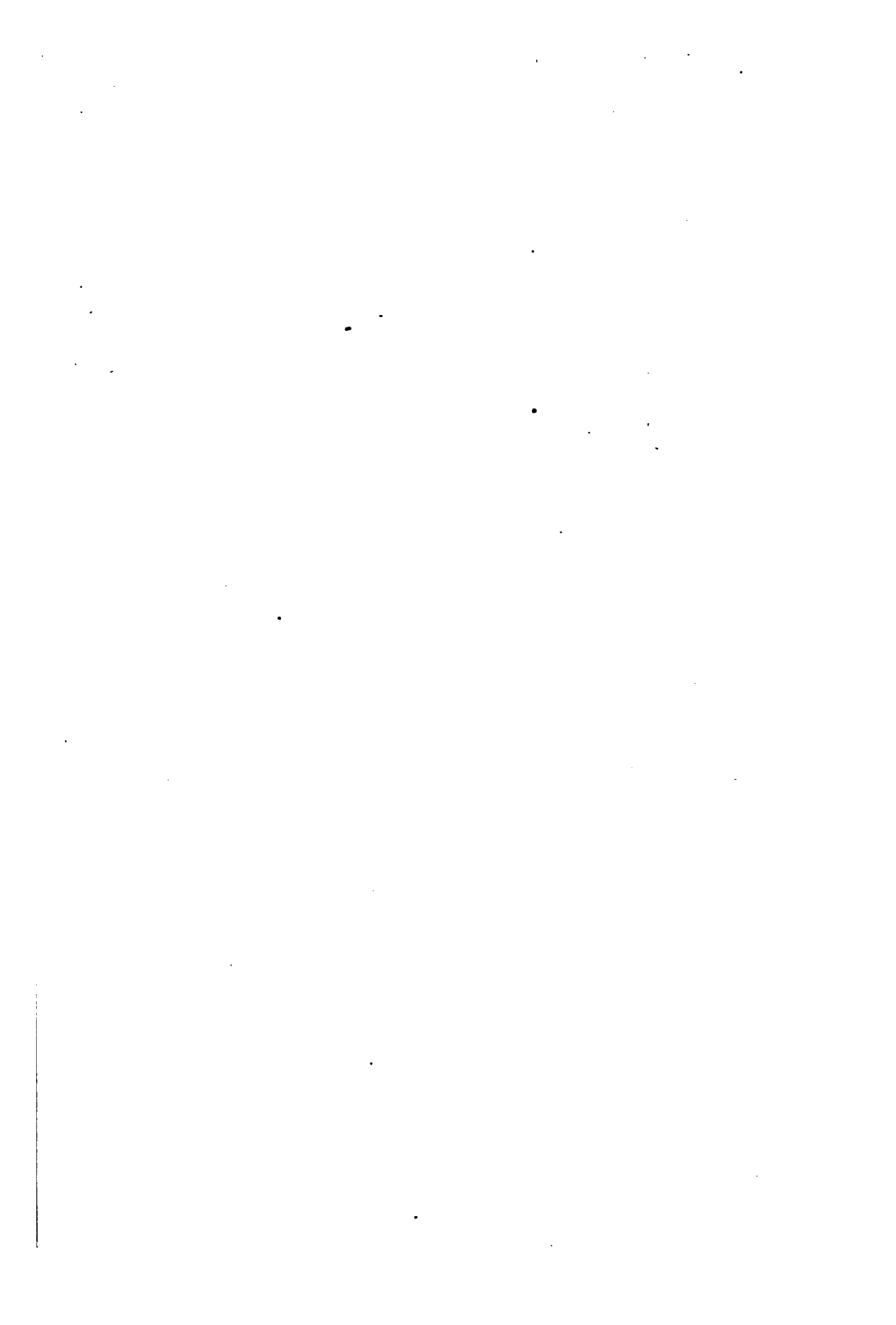














Engraved by W. H. Storer

MICHAEL ANGELO BUONAROTTI

*From a Sculpture by T. Stanetti,
in the possession of the Right Hon. Earl Spencer.*

Under the Superintendance of the Society for the Diffusion of Useful Knowledge

London: Published by Charles Knight, 25, Abchurch Lane, 1825.

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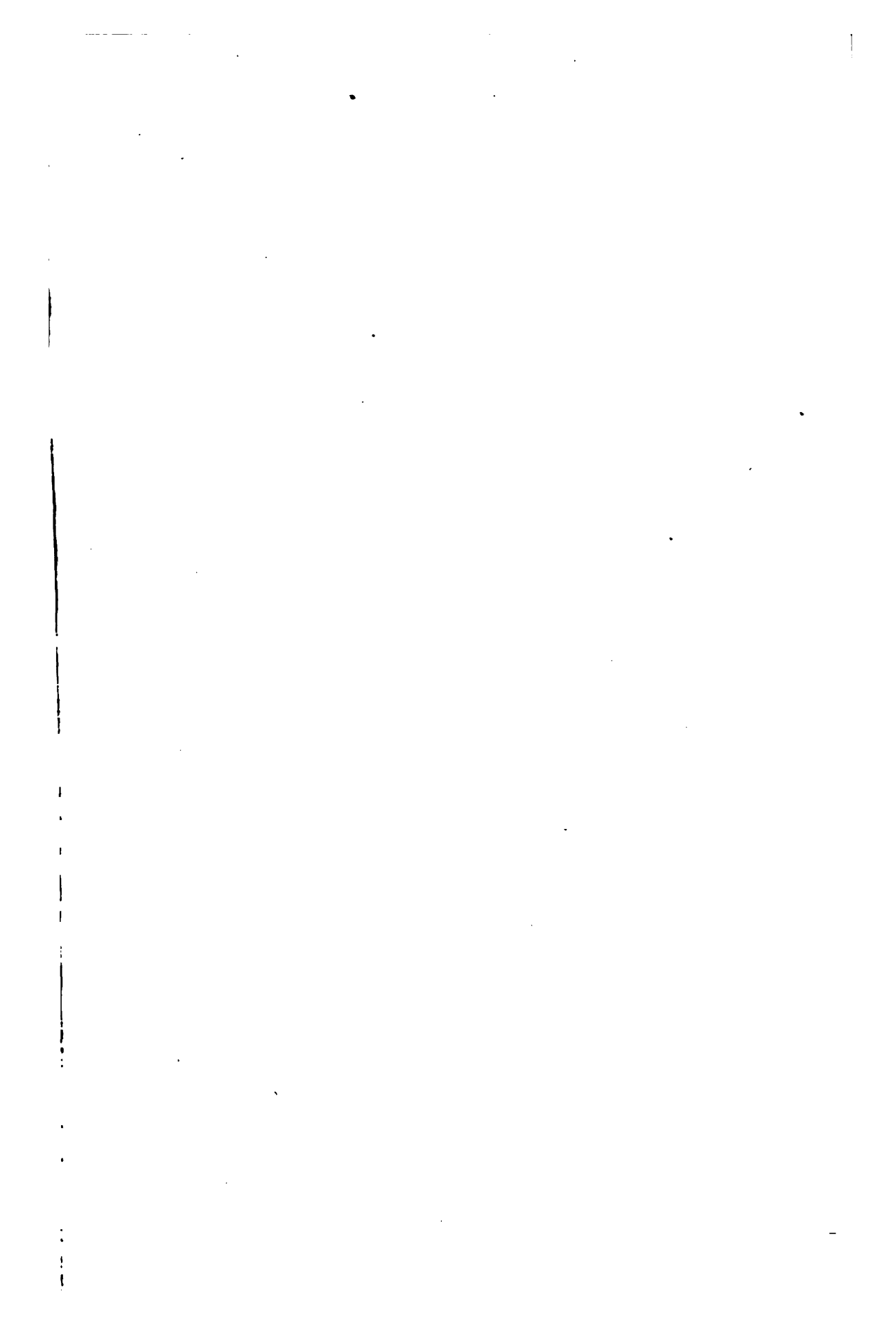


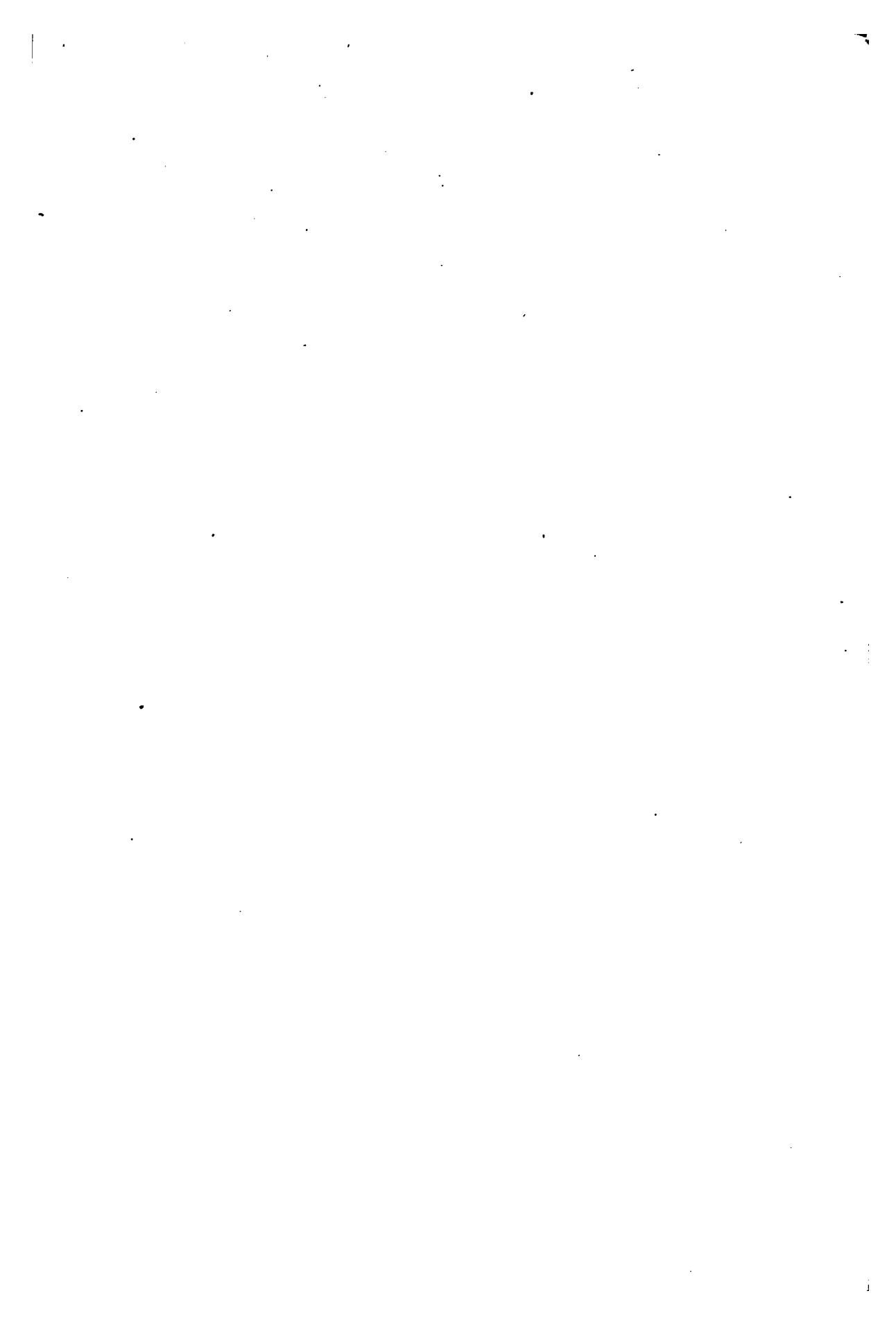
R. W. Doss, Del.

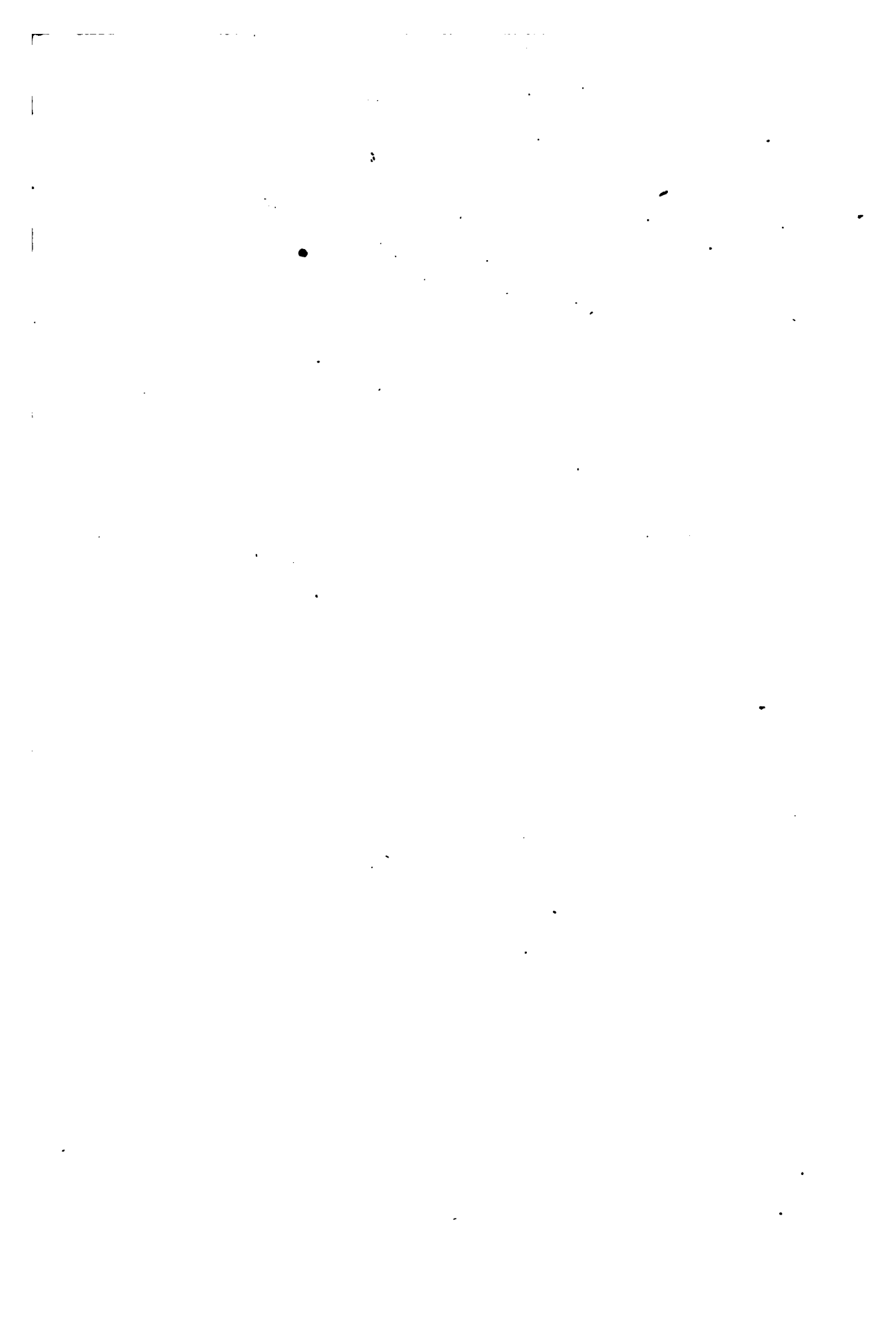
A. J. Meann, Sc.

**AFTER A FRESCO PAINTING,
IN THE SHOP OF JOSEPH MAYER, GOLDSMITH,
LIVERPOOL**

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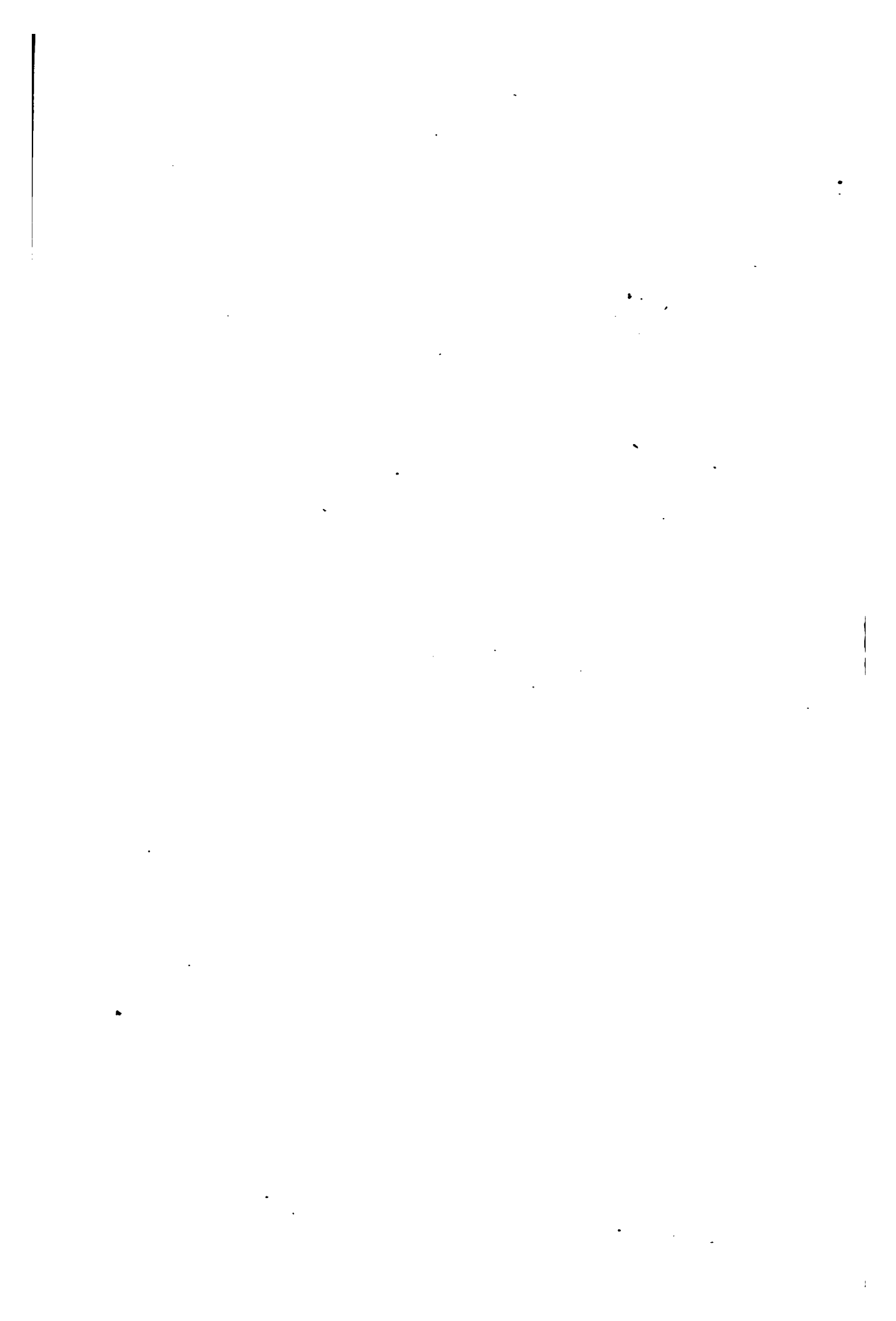
















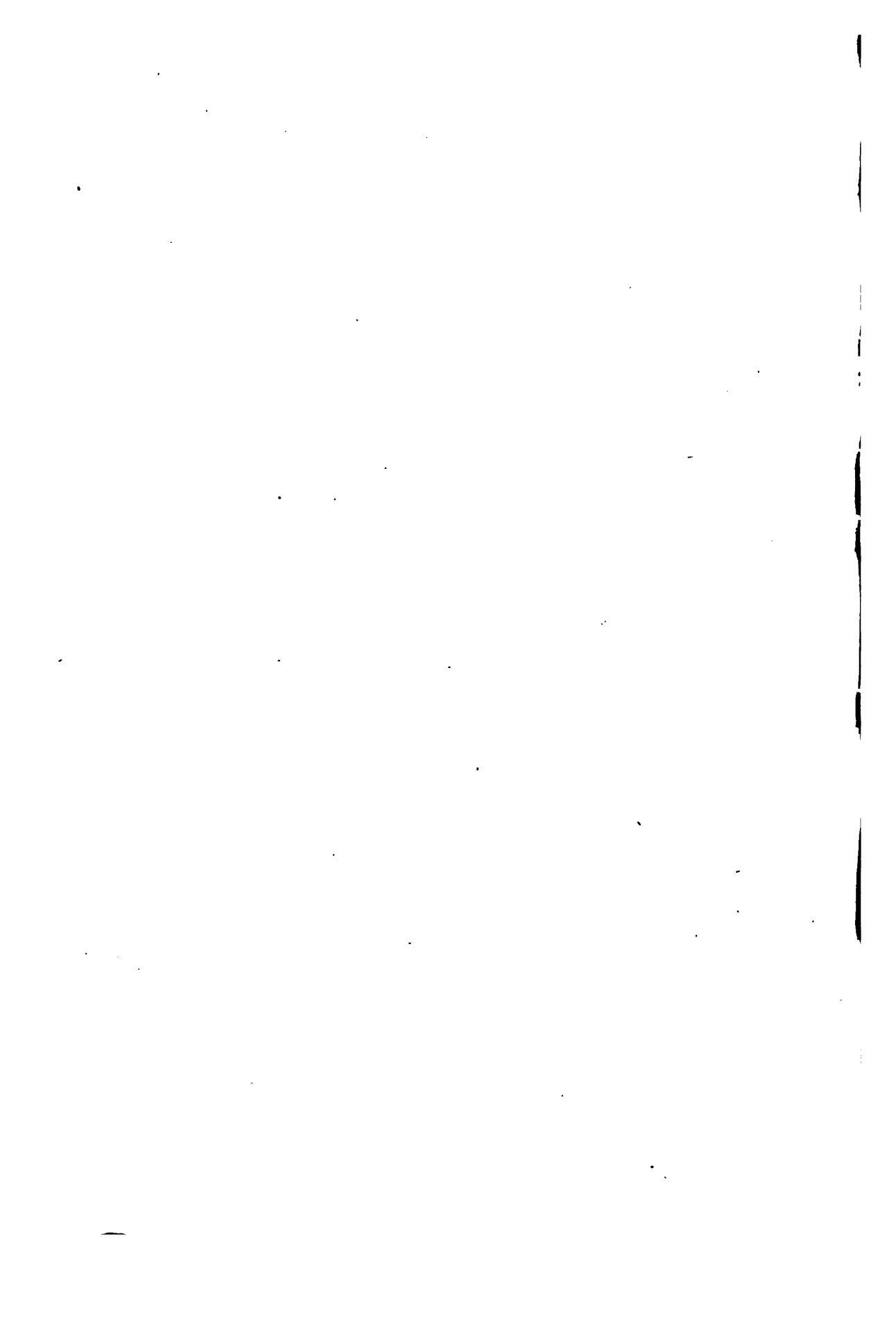
- The Lynn Cup -

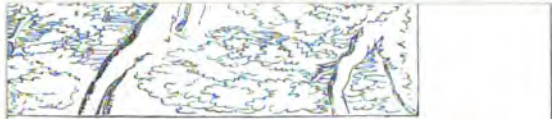


The Corporation of Lynn, in Norfolk, are the owners of the enamelled CUP, popularly called "King John's Cup," from the received tradition that that sovereign presented it to them on his memorable visit to that town. It is, however, now satisfactorily determined, from internal evidence, to be a work of the fourteenth century. It is of silver, partially gilt, and decorated with figures apparently engaged in hawking, accompanied by symbols of the chase. It is richly enamelled, and from inscriptions beneath the foot, it appears to have been re-enamelled frequently, unless we are to consider that it was merely a restoration of the varnish which covered it, as the enamel presents strong features of originality. The entries in the corporation books show that it was known as "King John's Cup" as early as 1548, and in 1595 we find an

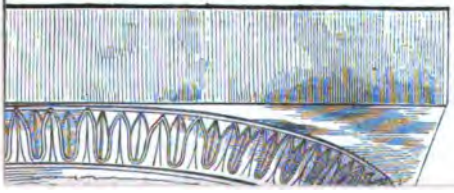
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The Ivory Bas-Relief, ascribed to Flamingo, repre



The Salt-Cellar.

" The position of the Salt-Cellar on the dinner
" tables of our Ancestors. Occupying its centre,
" it became the mark of rank and position
" for the guest to be seated "above the salt,"
" the envied locality of those below it, who would
" feel from that circumstance a social distinction,
" publicly made and recognised as such by
" all guests at the board. Accordingly, the "Salt"
" became a large and distinctive piece of plate,
" and specimens have often been confounded
" with the tazzas and drinking cups of the
" Sixteenth Century, to which they bear much
" general resemblance. We engrave on our
" present page the silver gilt Saltcellar
" belonging to Christ's College, Cambridge, upon
" which are the royal badges of the Rose, fleur de lis
" and portcullis. It is apparently a work of
" Henry 8th time, and a present from Royalty. -
" (Art Union)

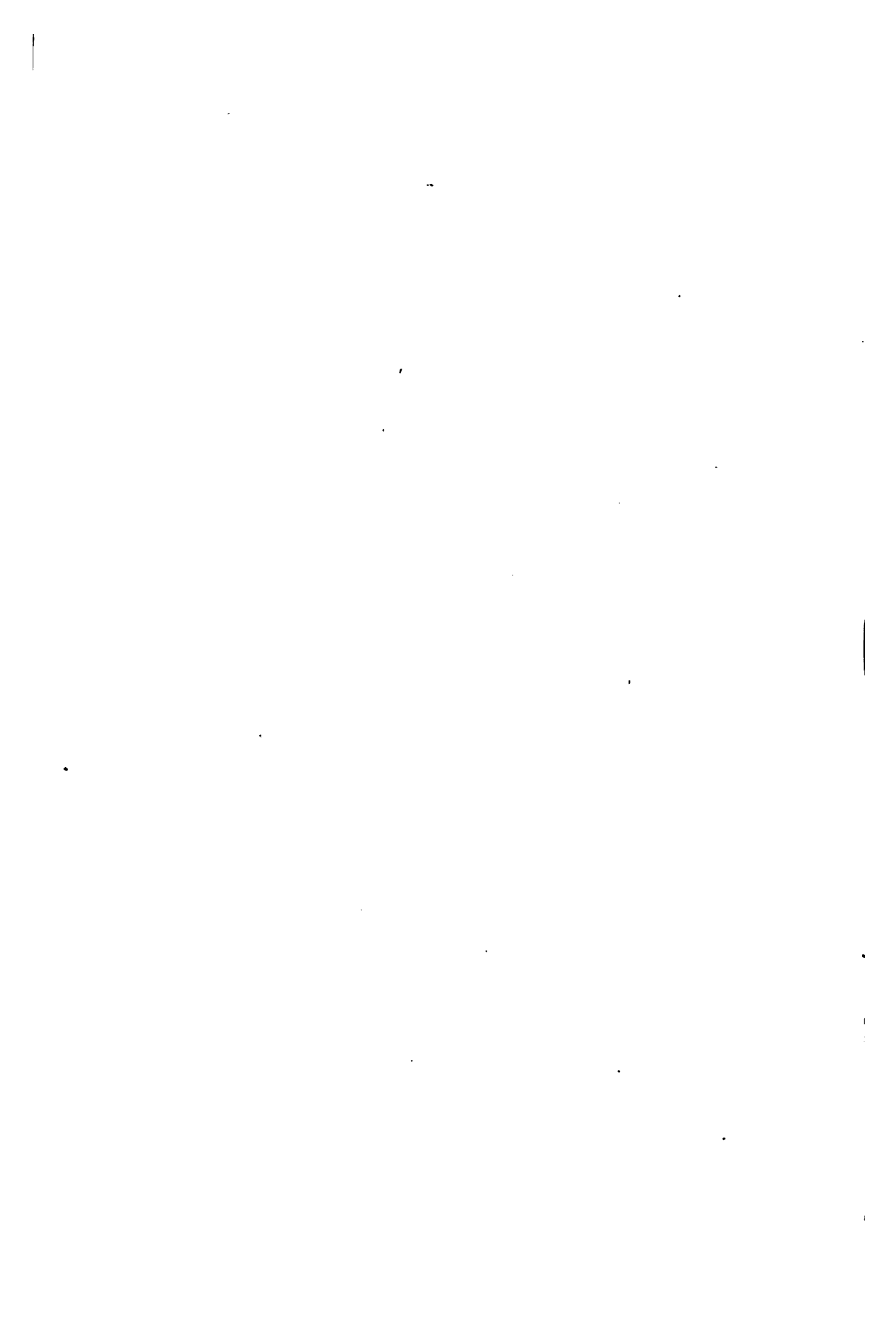
The Salt-Cellar, belonging to Christ's College Cambridge.

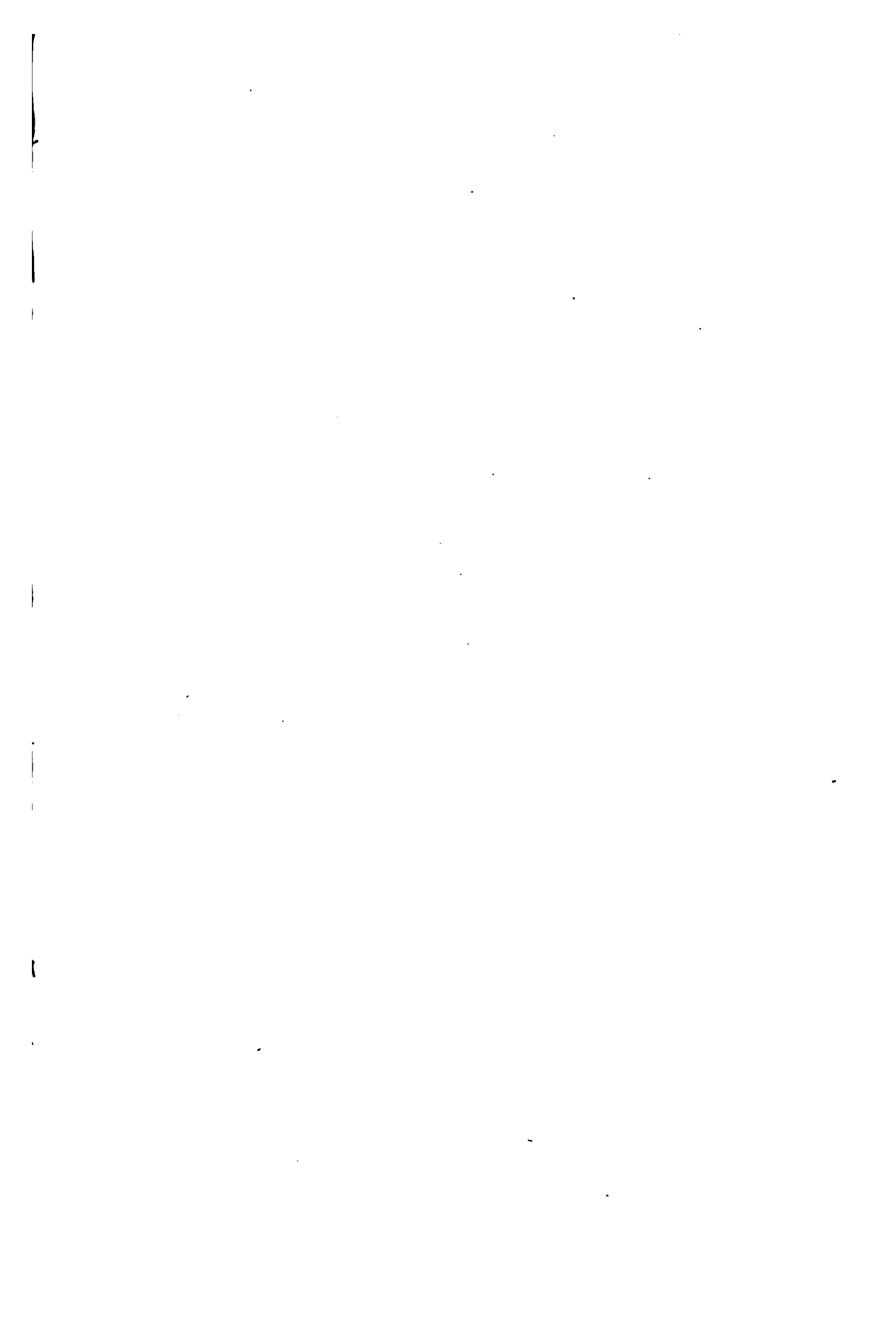


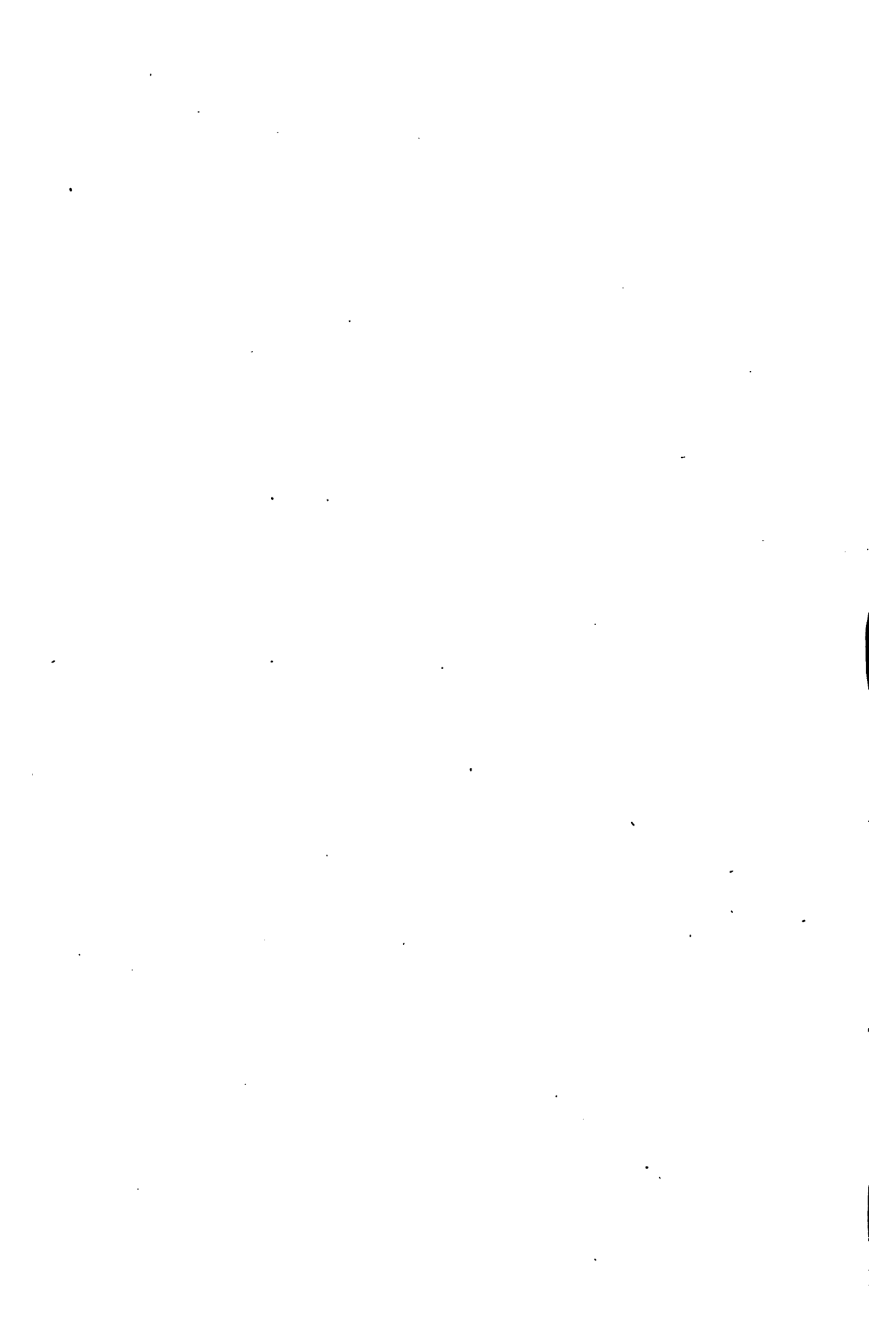
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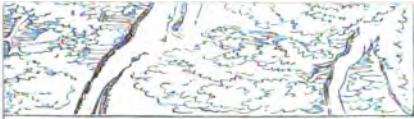
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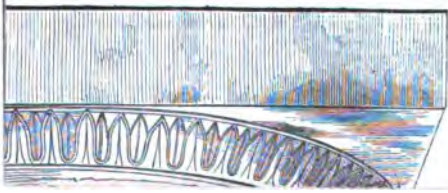








The ivory Bas-Relief, ascribed to Flemingo, repre



The Salt-Cellar.

"The position of the Salt-Cellar on the dinner
" tables of our Ancestors. Occupying its centre,
" it became the mark of rank and position
" for the guest to be seated "above the salt,"
" the envied locality of those below it, who would
" feel from that circumstance a social distinction,
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The Salt-Cellar, belonging to Christ's College Cambridge.



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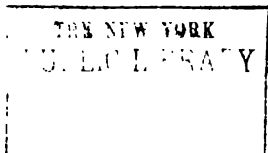
of refined taste, not underserving of the title of his countrymen. It is much to be regretted that our information concerning him is so scanty, for although he died in the very prime of life of Italy. Their works do for them what Vasari has done little in giving matter for the biography of her artists; no one has done little in giving



Le Sueur was born at Paris in 1617, and at an early age was placed by his father, a sculptor of the Barberini Palace, works; in 1624 he was Academy of St. Luke. that period held in high estimation. Vouet little repute, in the school of Simon Vouet, at

valery.

Midds. Essex Per fesse nebulee or and sa
three Greyhounds' heads coupes, counterchanged
collared gu. Studded or.





The small upright silver Chalice is from the collection of H. Magniac, Reg. It stands on a foot of hexagonal form. The upper part rises in the shape of a crocketed pinnacle, and on two sides are tubes for the insertion of a cord or chain. It was used to contain the consecrated oil, used in the Romish and Greek churches for baptism, confirmation, and extreme unction.

with undulated rim; a tall DRINKING-GLASS, with twisted stem, and internal spiral thread of blue and white; a two-handled VASE, with cover, ornamented in white with undulating patterns; an elevated TAZZA, with frosted bowl; and a TAZZA, the stem of which is relieved by blue ornament.



projecting bands between the lion's head might, however, have been omitted with advantage, inasmuch as they destroy the effect of an other-

wise perfect work, and break the lines of the general composition in an unpleasant manner, while they seem to serve no purpose of utility.

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scenes, ascribed to Flamingo, and the property of B. L. Vulliamy, Esq.



Urino, Guidobaldo II, it visibly declined in taste and beauty after his death in 1674. The present specimen has good form, but bad decoration.



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The silver-gilt Cup is the property of Pembroke College, Cambridge. It is a work of the fourteenth century, inscribed "Sayn Denes y' es me dere for hes lof drenk and mak gud cher;"

the letters V. M., are for "Valence Marie," the original name of the college, founded in affectionate and lasting memory of Aymer de Valence, Earl of Pembroke, by Mary de St. Pol, his widow.



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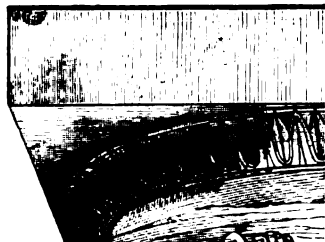
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RELICS OF MIDDLE AGE ART.

PART THE SECOND.

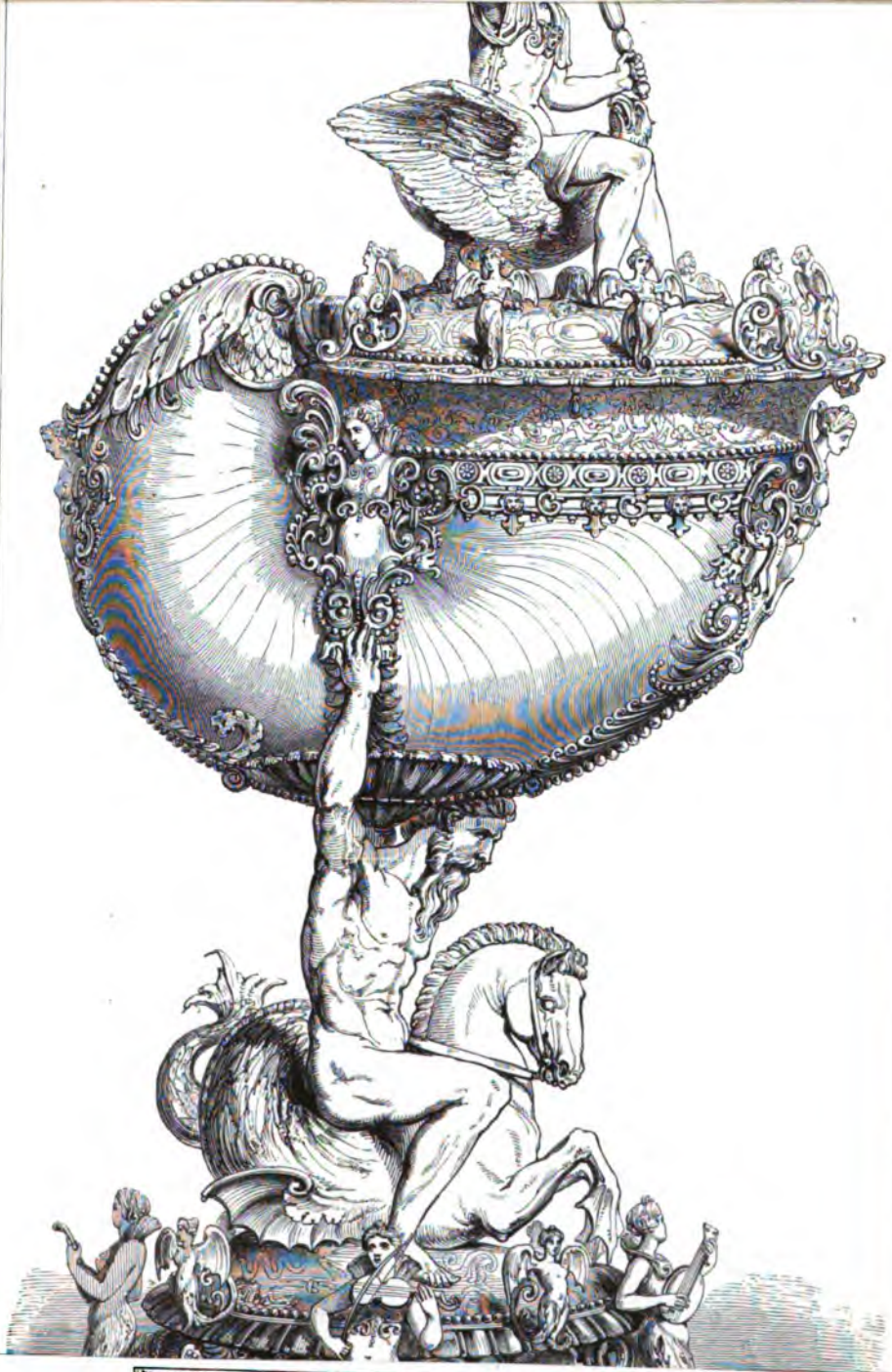
THE NAUTILUS SHELL, mounted in silver, and enriched by gilding, with which we commence our present series, belongs to Lady Beresford; and is a work of the seventeenth century. Fully exhibiting the peculiar tastes of that period, the decorations are of a varied and highly-enriched kind. Figures, fanciful and real; caryatides, and arabesque ornaments, give strength and beauty to the mounting, which is also elaborately studded with emeralds, sapphires, and other precious stones. Such cups, intended for the royal, noble, and wealthy, received at the hands of the goldsmith an amount of costly care and fertility of well-studied enrichment, upon which his best taste and attention were directed. There is a wonderful variety observable in these old works, evidencing the constant thought bestowed on their



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The ivory TANKARD is of Flemish workmanship, and is carved in high relief, with figures allegorical of Intemperance. It was executed in the seventeenth century, and now belongs to the Baron Rothschild.

silver gilt, a fine specimen
to A. W. Pugin, Esq.



FOR SALE
BY
PHILIP M. ...

ASTORIA, OREGON
1940

*Entered the property of Lord de Maudley, 16th Century Work
representing the Triumphs of Andrea Doria - purchased of
Lummelini family; -*



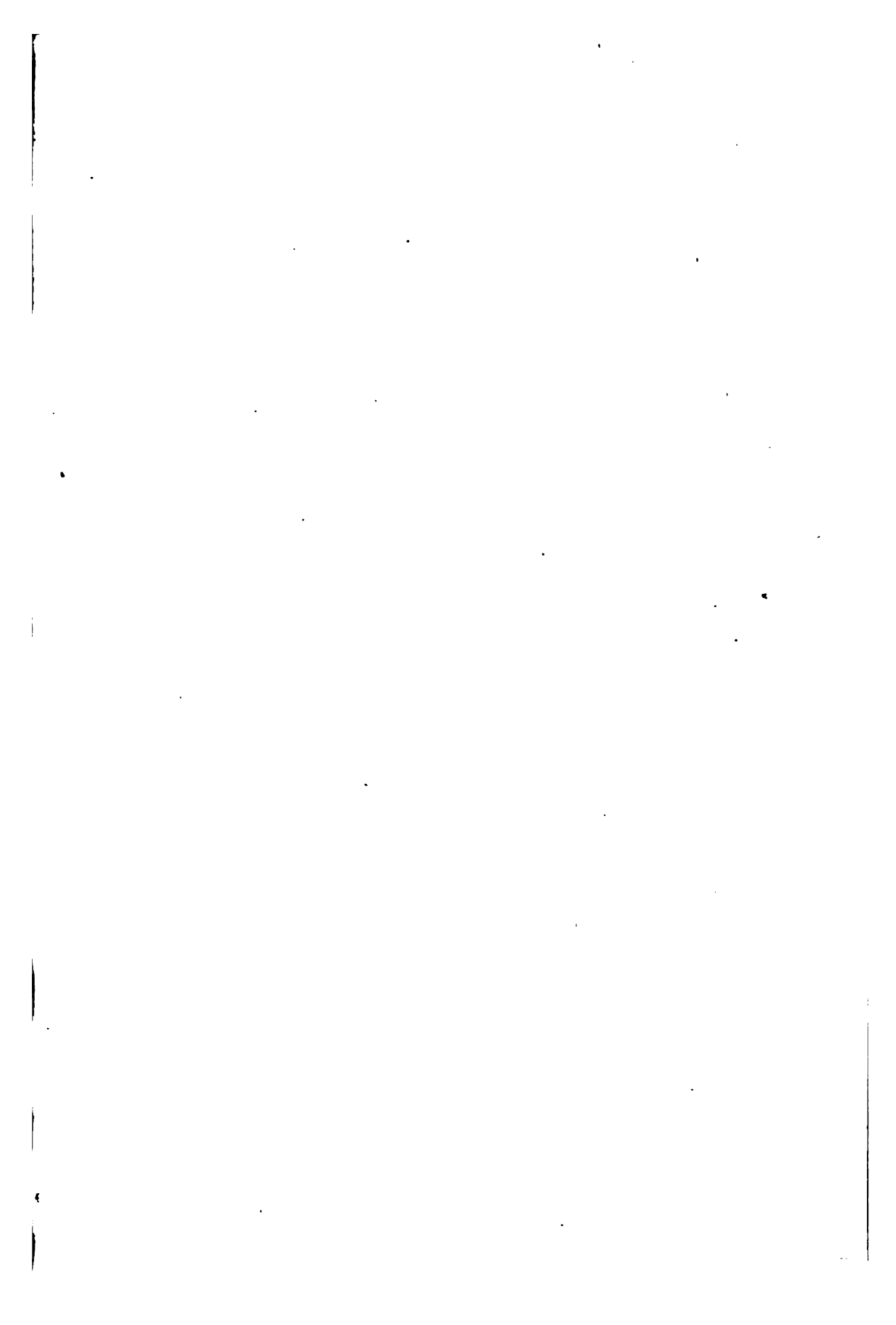
THE
EQUITY

in the fifteenth and sixteenth centuries, those of Germany, principally at Nuremberg, in the sixteenth and seventeenth centuries, did even more, for they



came of art-manufacture, totally irrespective of the crown jewels of France, which attaches to its earlier history, as a

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OFFICE OF THE
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GENERAL INVESTIGATIVE
DIVISION
WASHINGTON, D.C.



NEW YORK
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The silver-gilt HANAP is a work of the seventeenth century, and is the property of Octavius Morgan, Esq., M.P. It derives its form from a pine-apple (see cut, p. 114), the arms of Augsburg, a city whence metal manufactures of an artistic class emanated in considerable quantities.

THE
FEDERAL
BUREAU OF
INVESTIGATION
U. S. DEPARTMENT OF JUSTICE



*Silver Grace Cup belonging to Henry Bevan Esq^r
Hamilton Place. Piccadilly*

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b



The Baron Lionel de Rothschild is the owner of the fine and curious glass Cup, of the later Roman period, represented in our cut. The body of this cup appears of an olive-green colour, but on being held against the light it assumes that of a bright ruby, in one instance varied with amethyst. On the exterior is represented in high relief, and in some places undercut, a Bacchante subject; in one portion of which a panther, broken, shows that, unlike the rest

of those fanciful
the attributes of
their combination.
part of this vase is



We now present the Sprook, which, in accordance with the usual routine, completes this *serie* of elegant articles of utility and ornament, which have engaged the best attention of the artist who designed and executed them. That artist's name has not transpired, but it is very evident that he is no unworthy student in the school of Flamingo, and has executed a task requiring much taste and fancy in a worthy manner. The entire series is the property of W. Tite, Esq.

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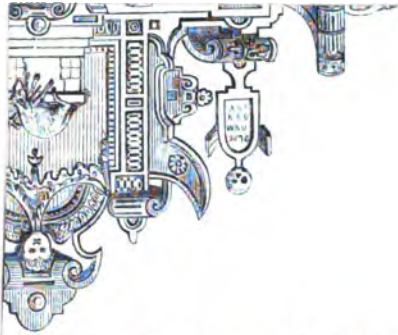
*Gent. Mag. Aug. 1828,
Pl. II. p. 113.*



CUP PRESENTED TO JAMES I. AT COVENTRY.

INTERNATIONAL
COMMUNITY

ANTHONY



The FRAME and BAS-RELIEF, representing Adam and Eve in the garden, is carved in wood of two kinds. The frame is ornamented with masks, cer-



The Baroness Rothschild also owns the quaint pine-apple CUR, which is of silver gilt, and enriched with figures and flowers; the lid is made to fit close, and form the



One of the most exquisitely beautiful productions of the *Renaissance* School contributed to the Exhibition, was the EWER of Sardonyx, mounted in gold, and enriched with precious stones, which is now the property of the Viscountess Beresford. It is evidently of Italian

make, and the beauty of design apparent throughout the entire work, places it high in the scale of Art-manufacture, totally irrespective of the intrinsic value of the materials, or the interest which attaches to its earlier history, as a part of the crown jewels of France.

FEB 10 1964



The Ivory Grou, ascribed to Flamingo, and representing infant bacchanals and satyrs playing with the ass which series of six table



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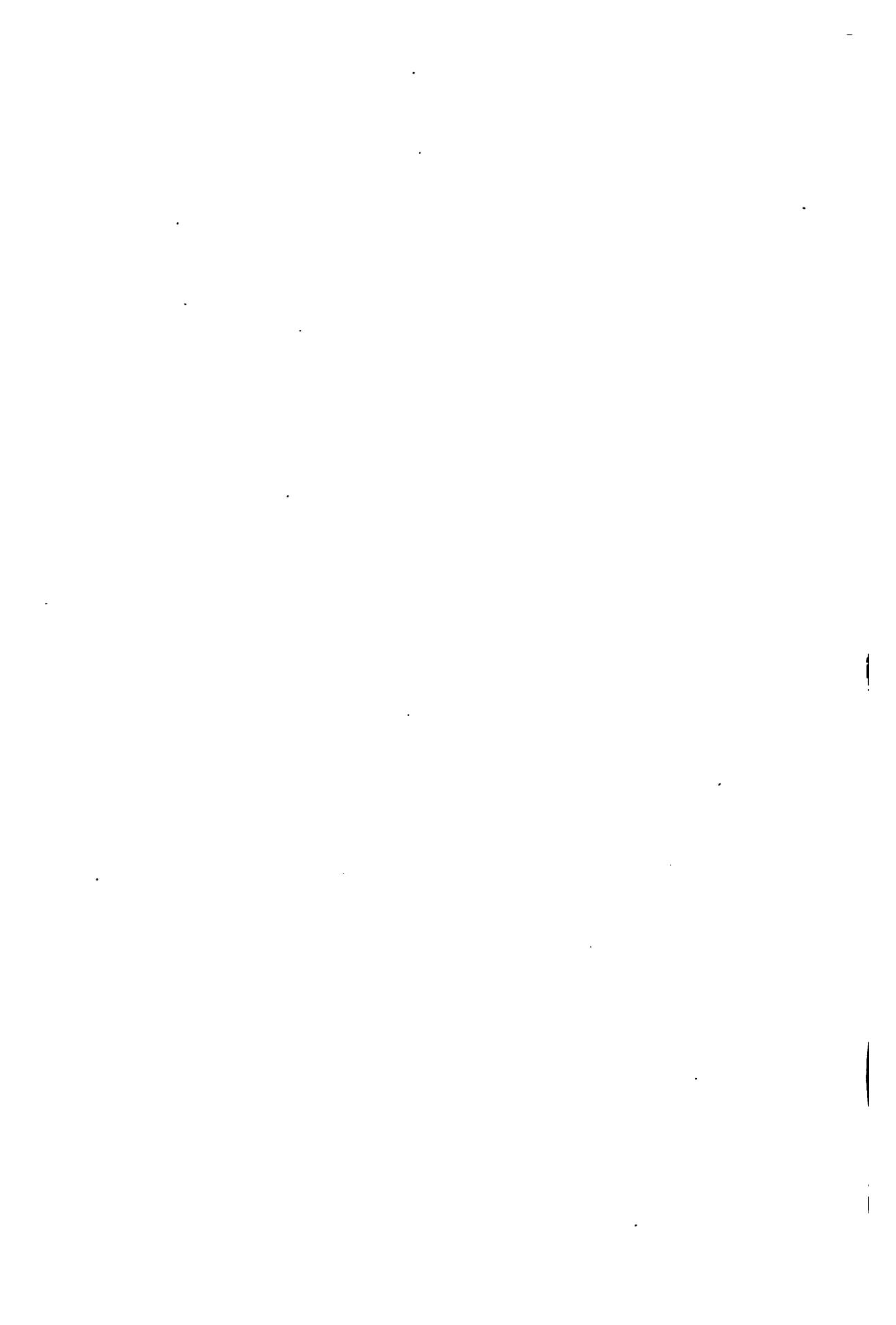
A
THIRD
FLOOR

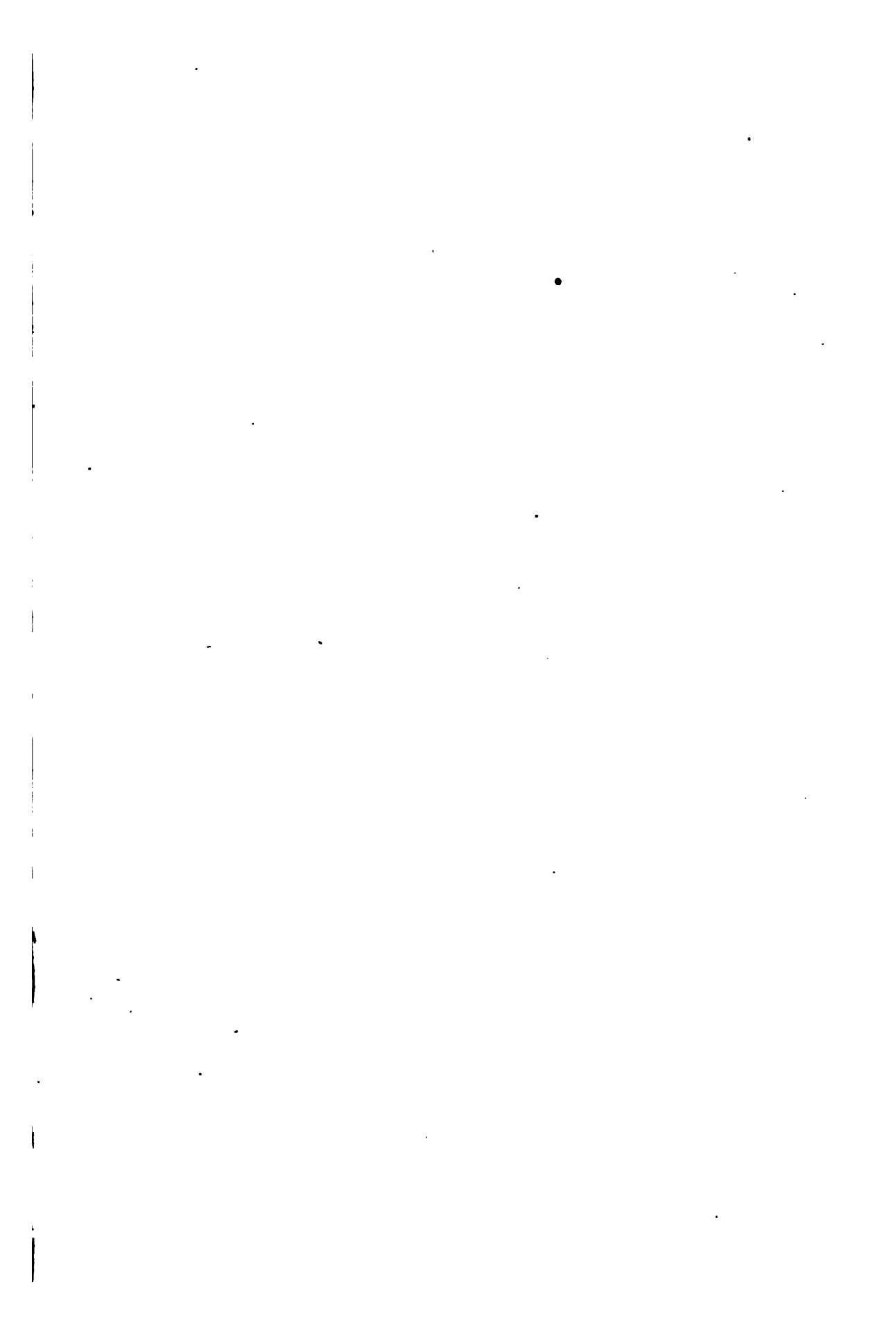


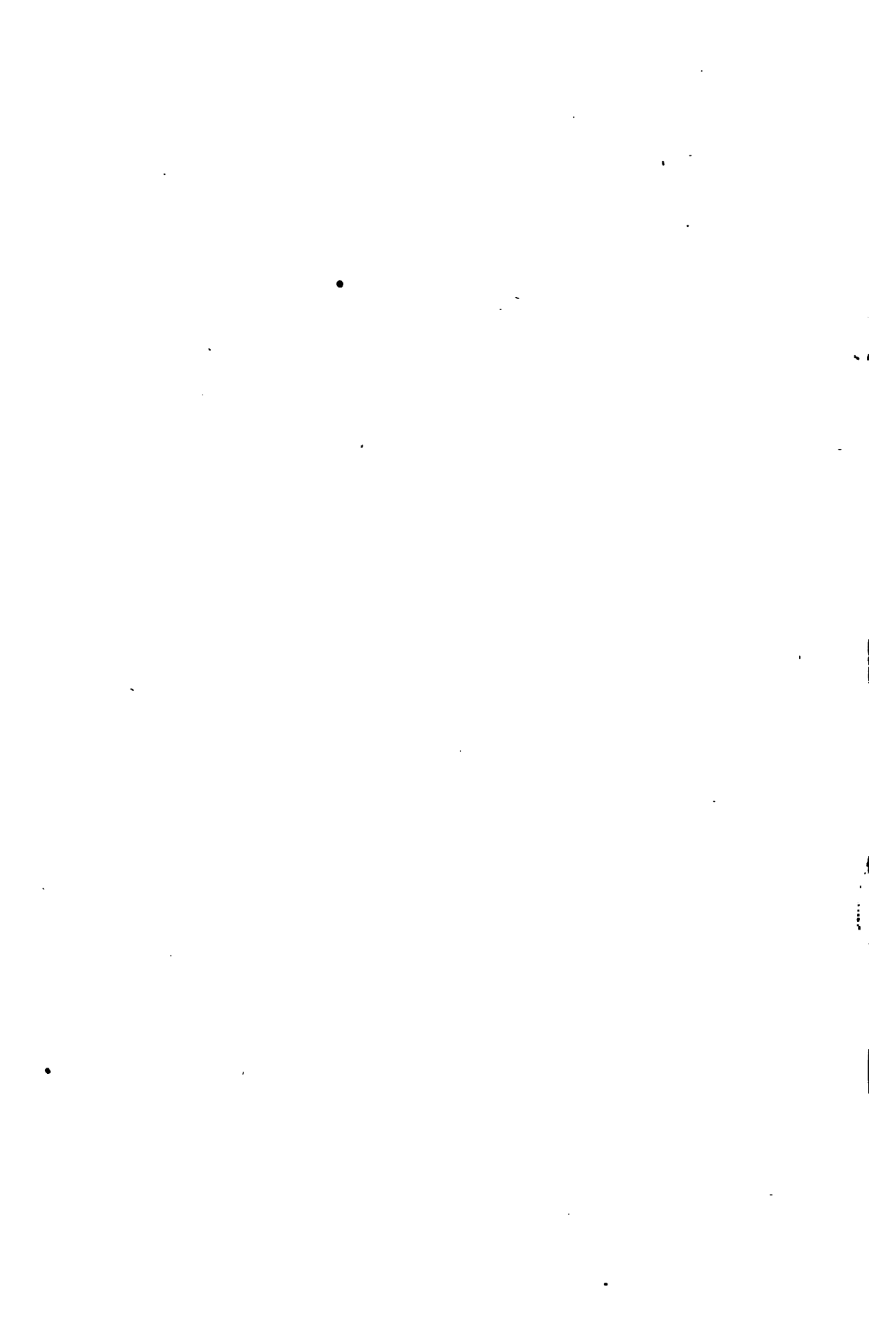
We have here another of the IVORY TABLETS, representing Bacchanalian

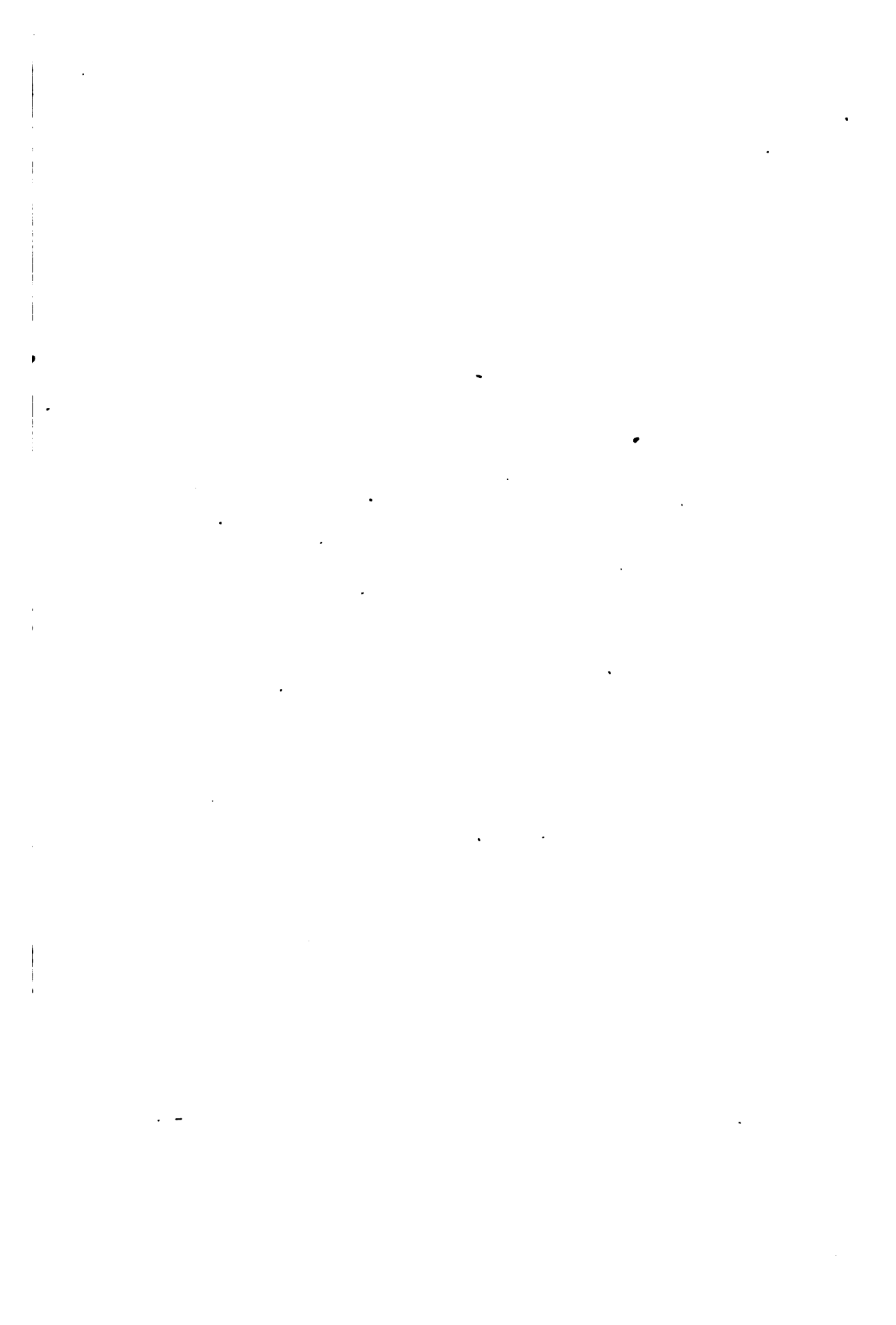


enamel, fading towards the edge, which is white, the centre being green with red spots. The ground work of the ornament on the staff and volute is filled in with blue. The medallion on the boss is perforated, the wings of the bird, the quatrefoils, &c., being green with red spots; the deep blues, also, are generally relieved by rows of dots of the same vivid colour. The effigy of the bishop, on the exterior of the tomb, held a similar staff. This curious work belongs to H. Magniac, Esq.

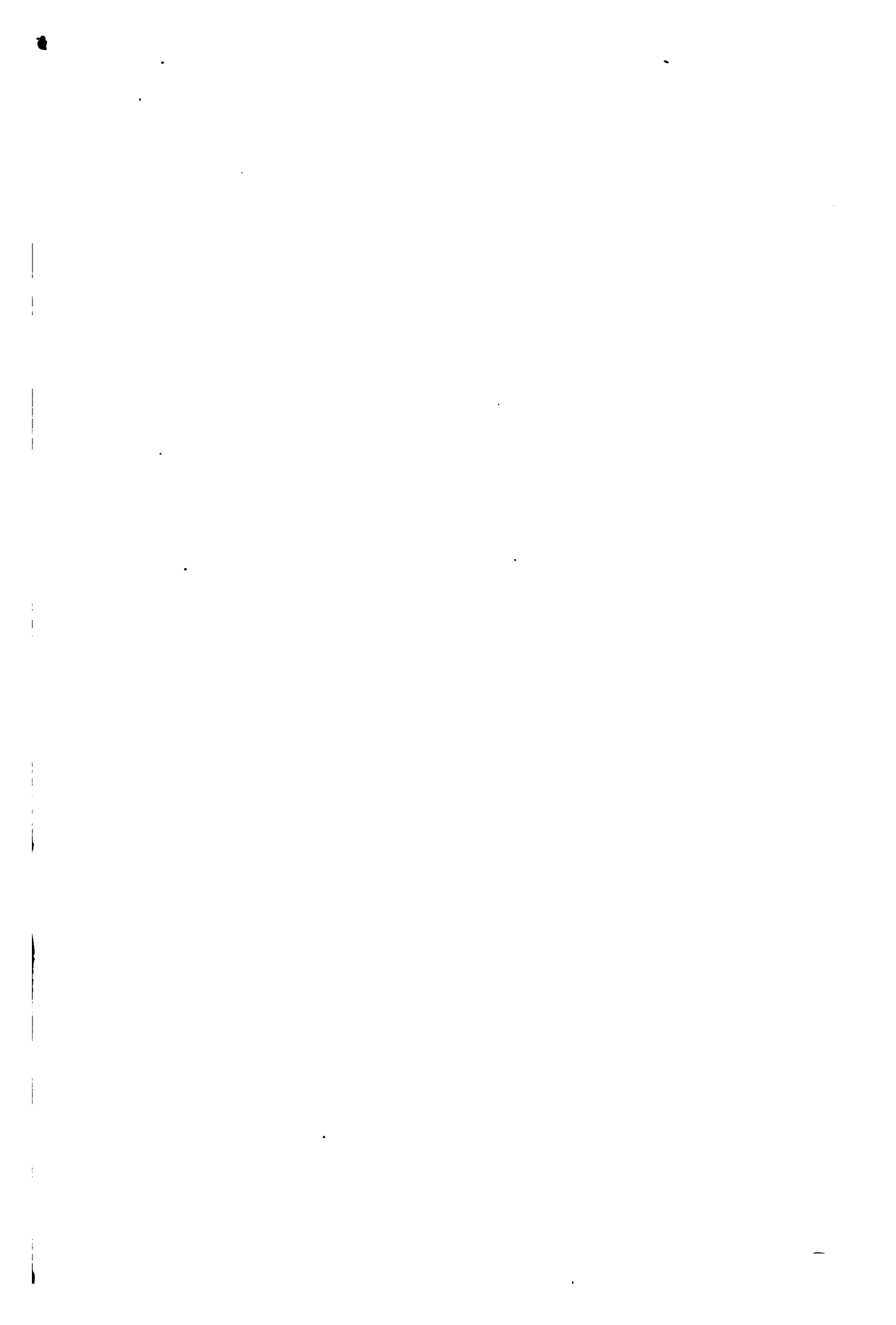


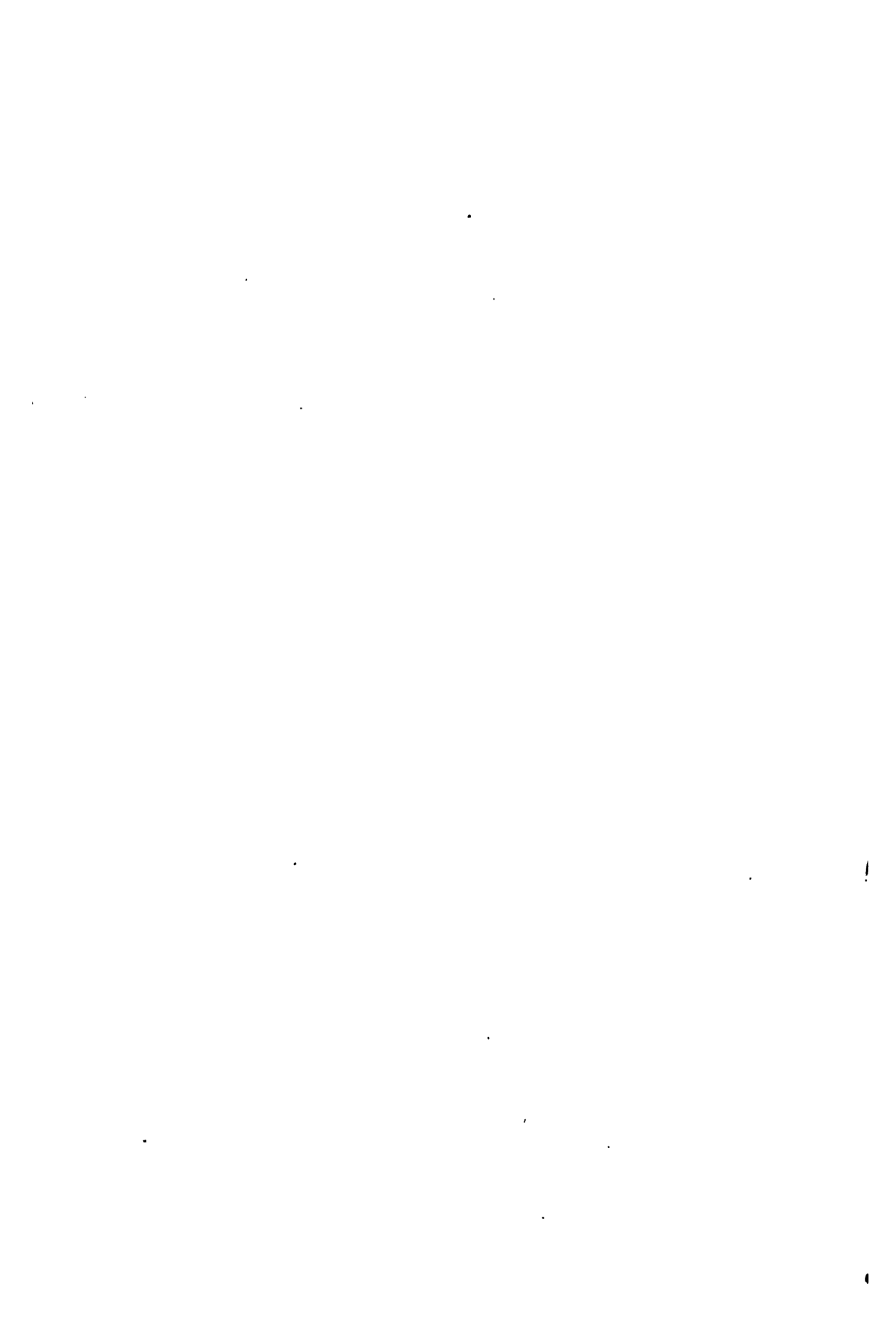


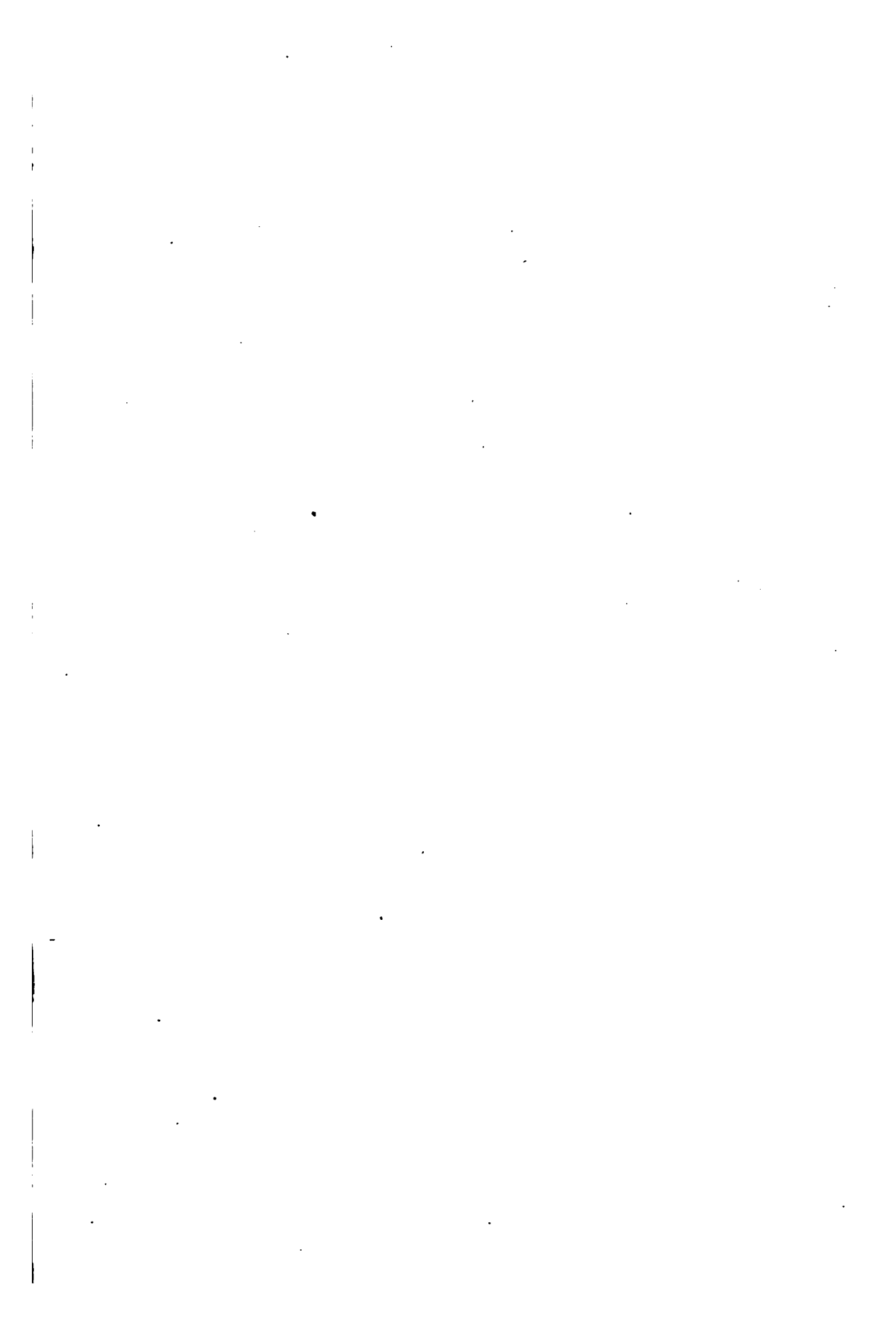


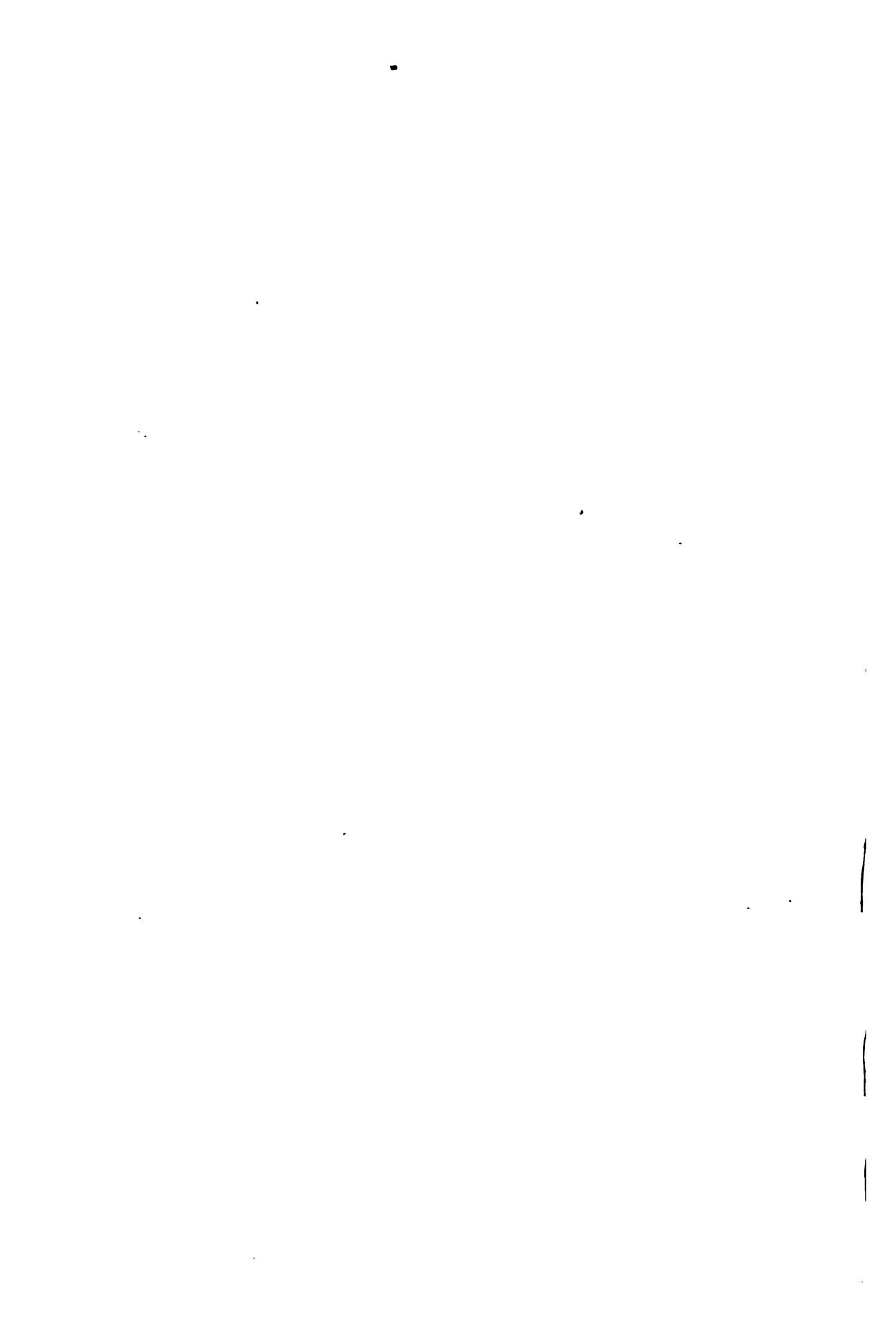


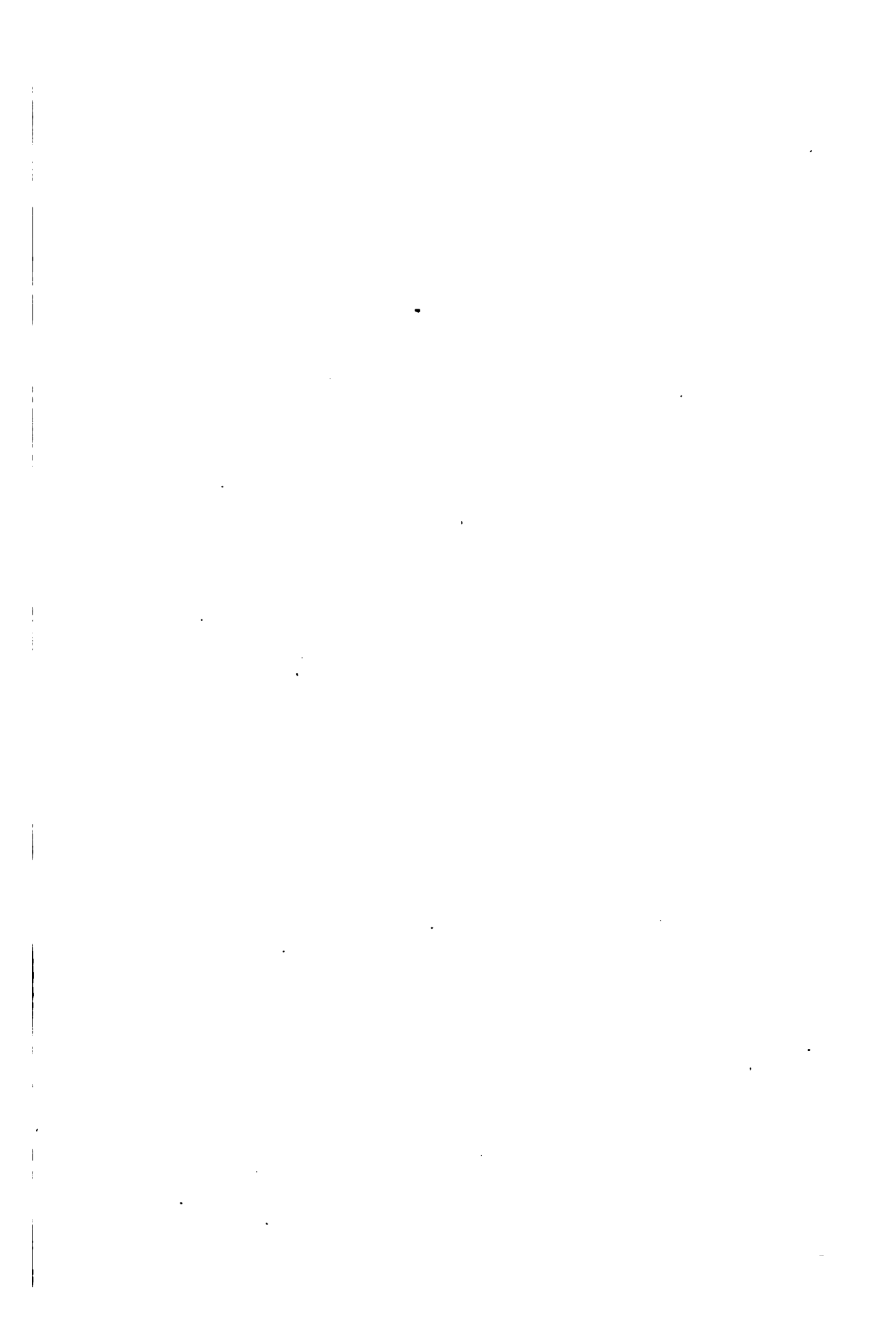




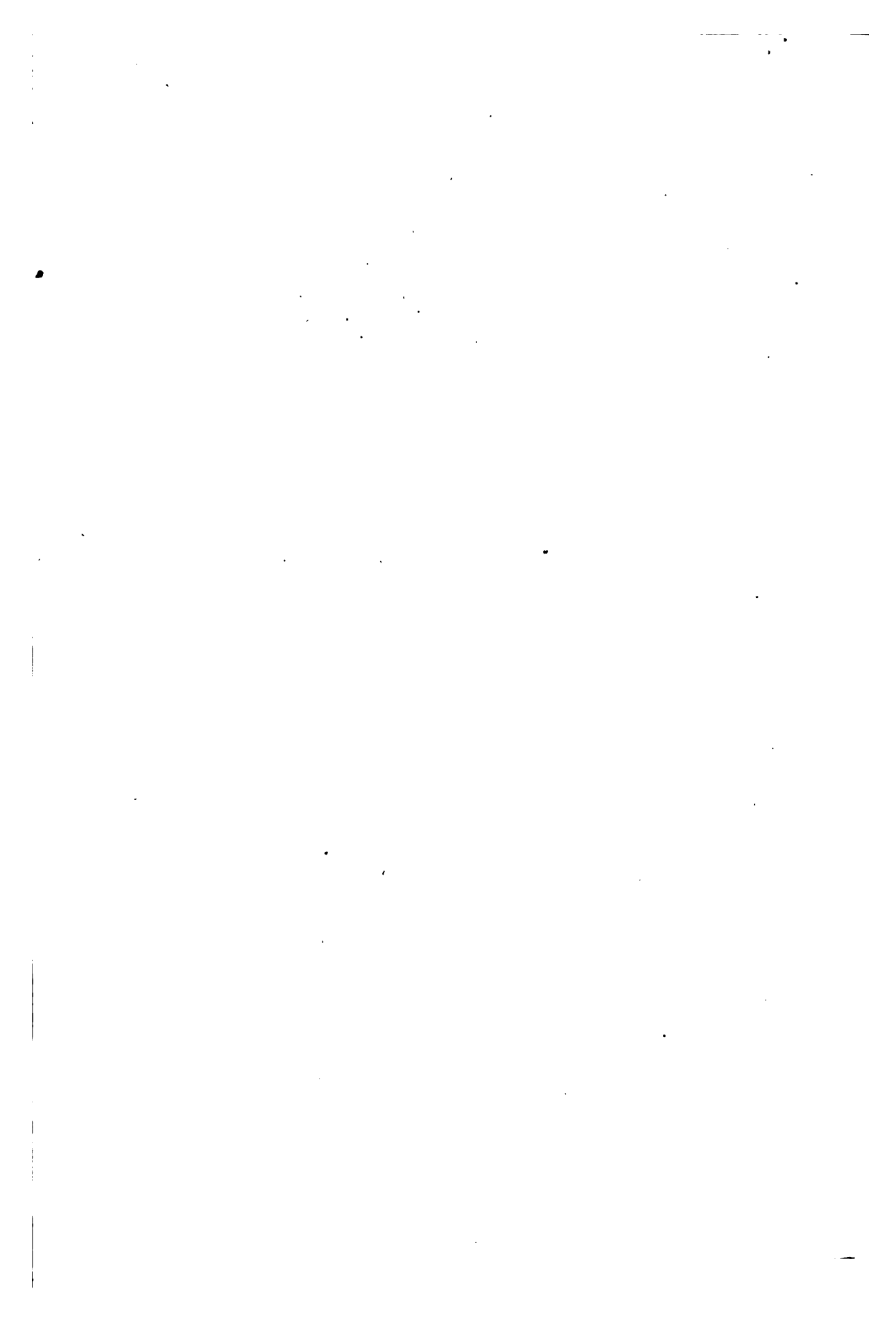


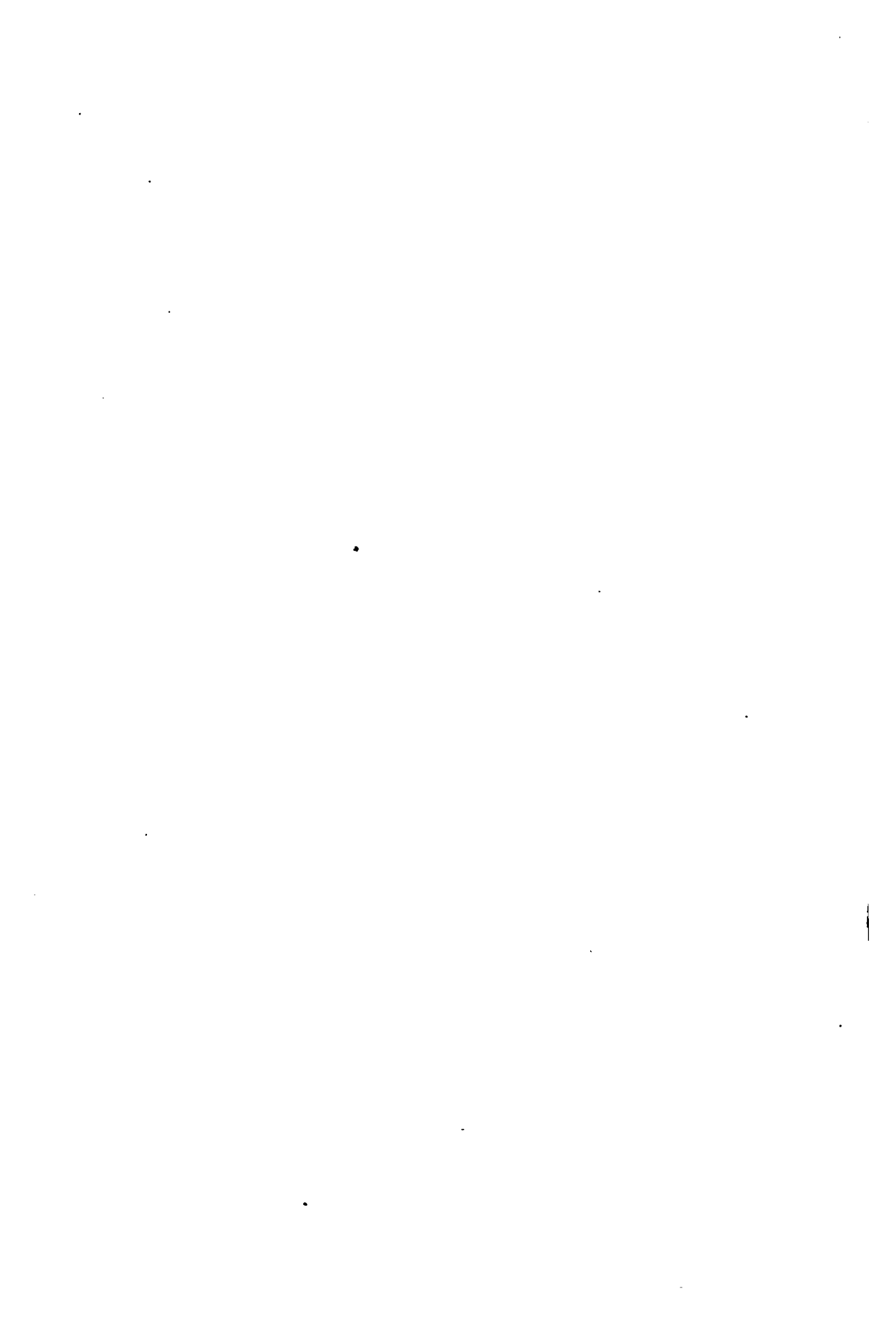


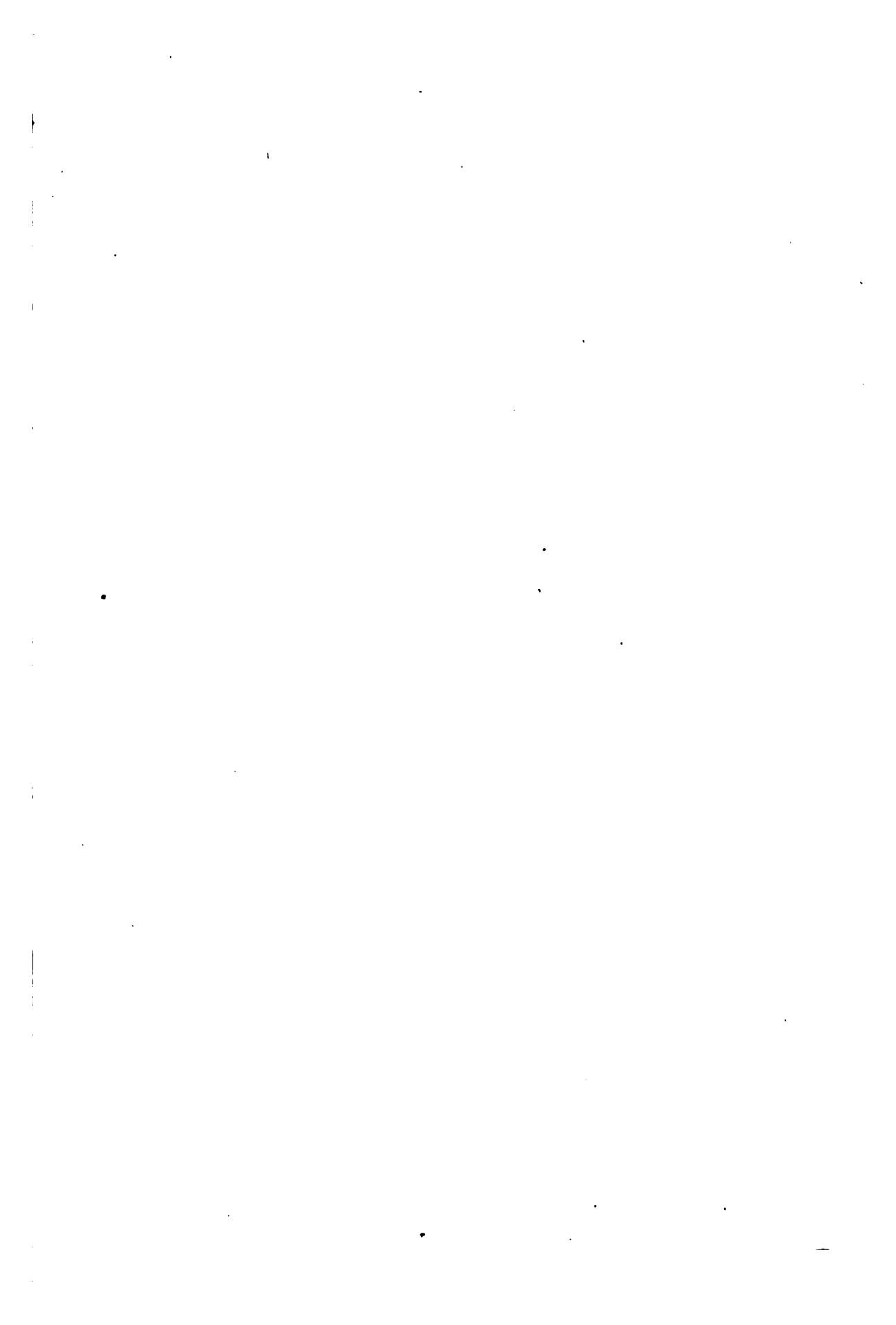










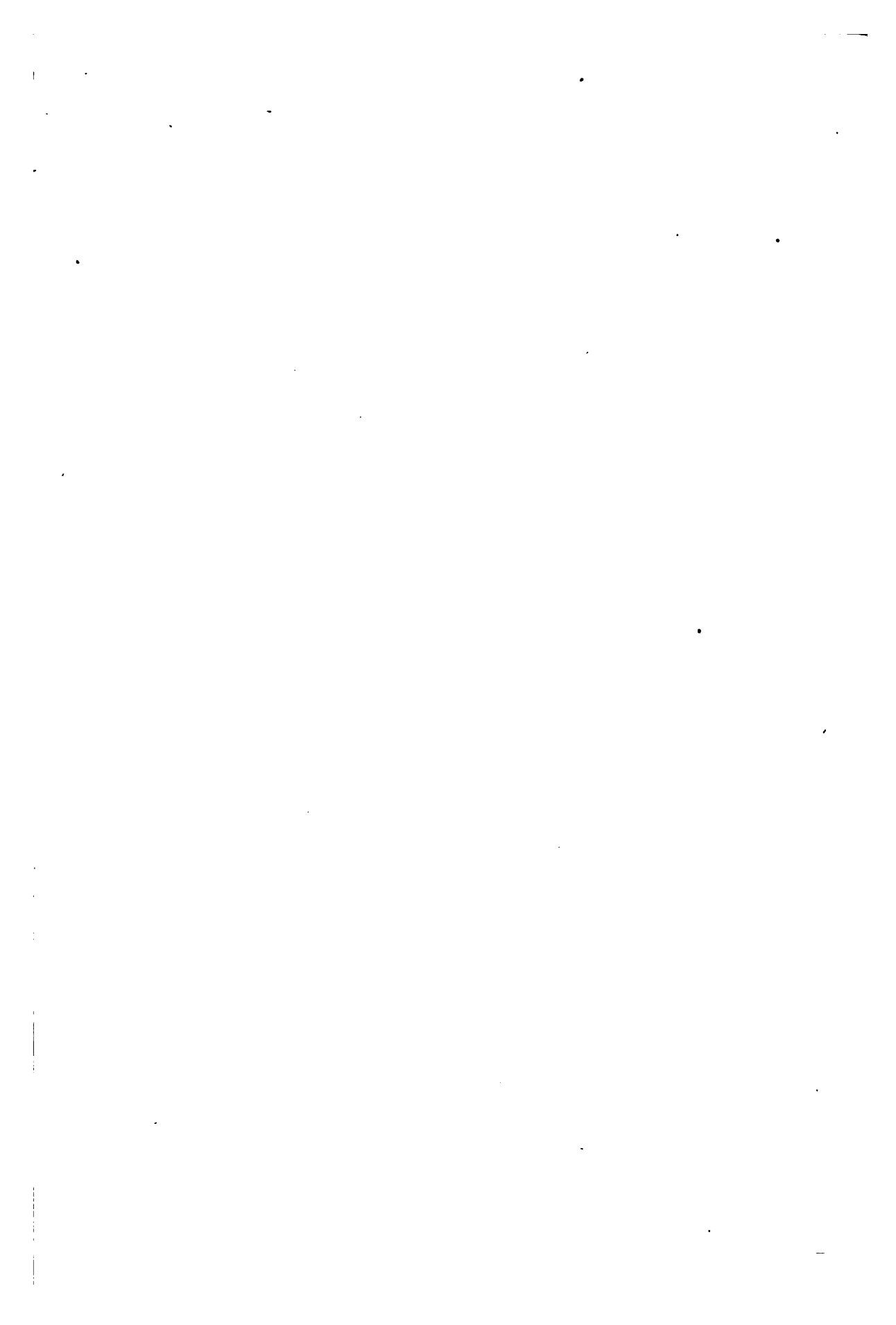










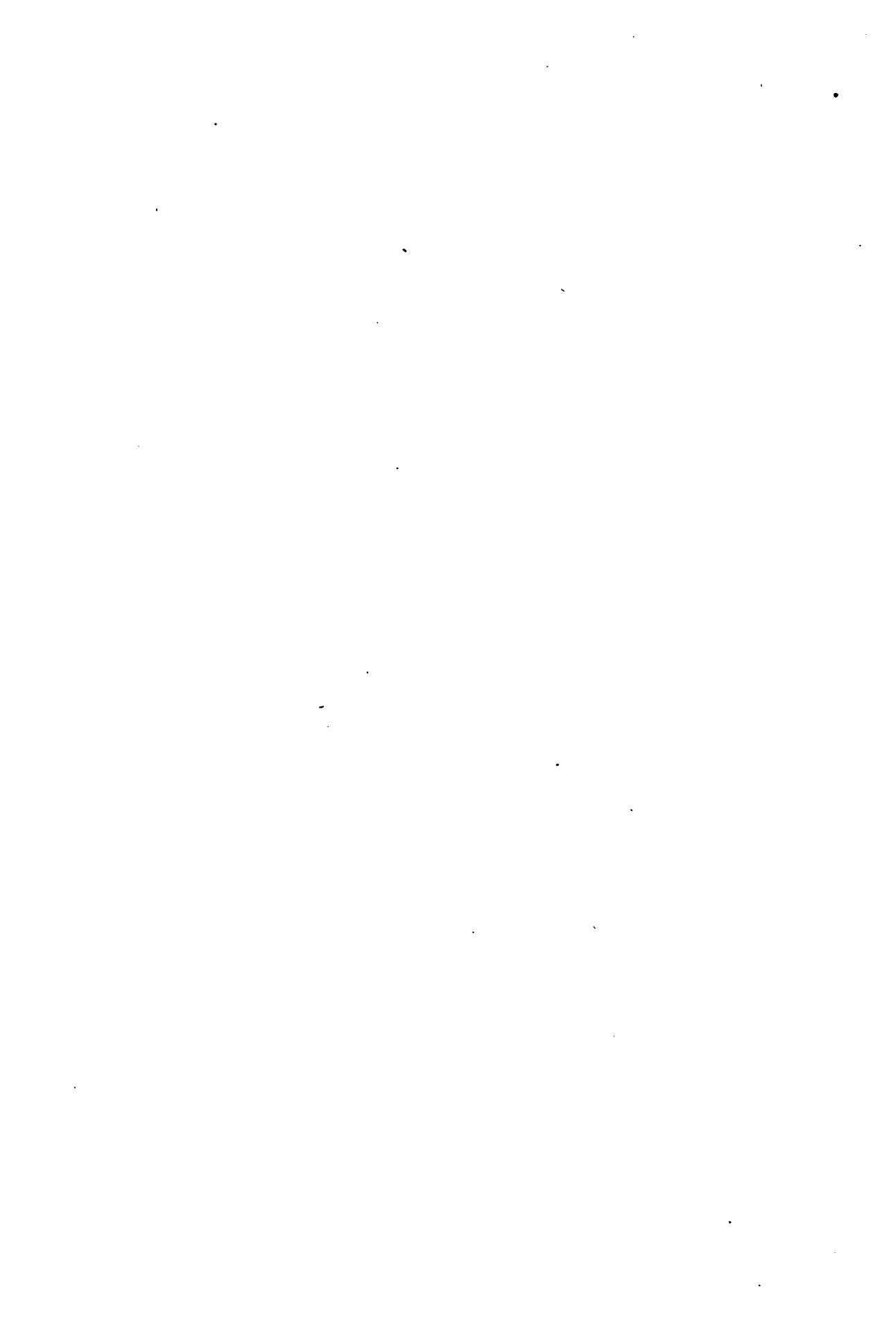


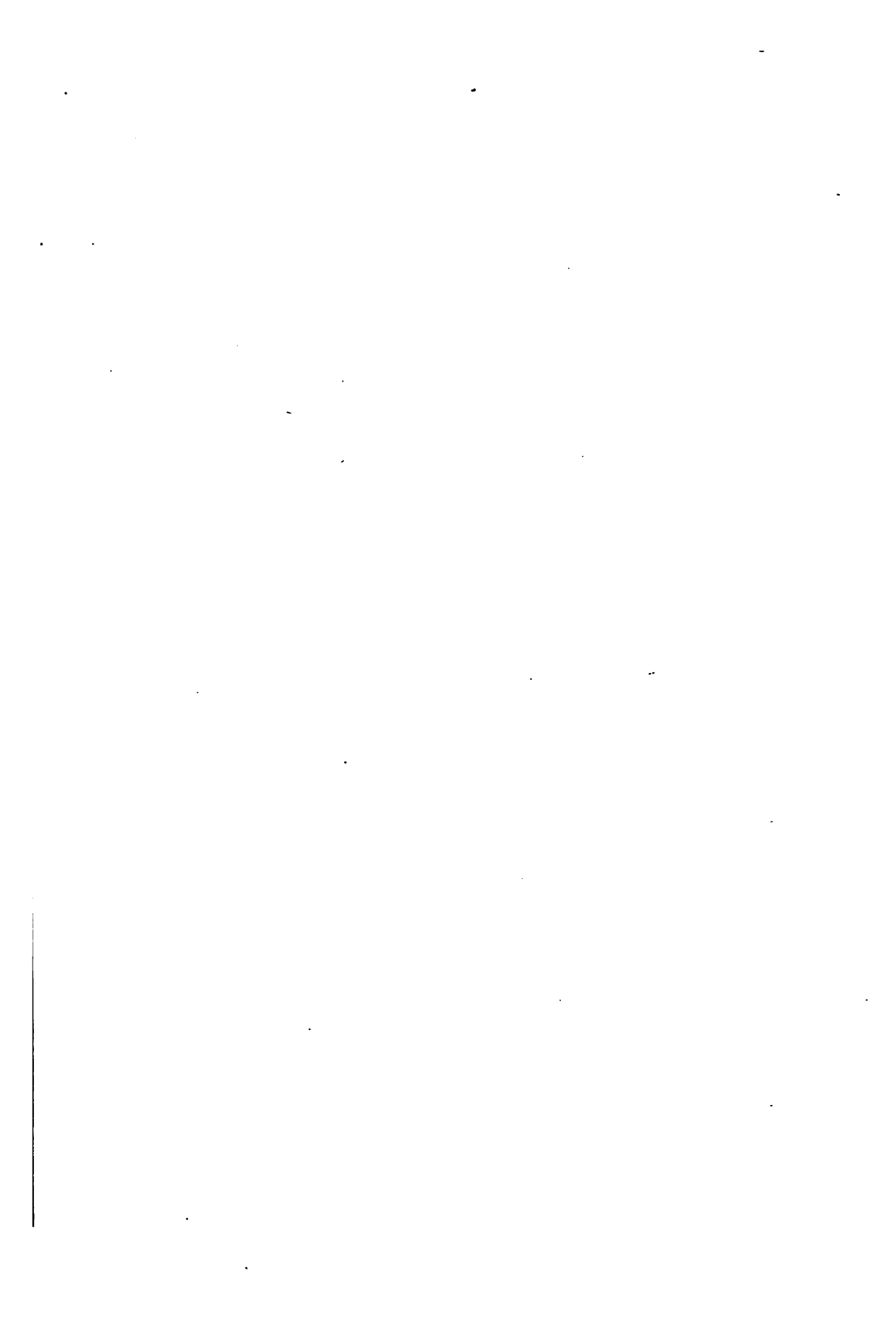


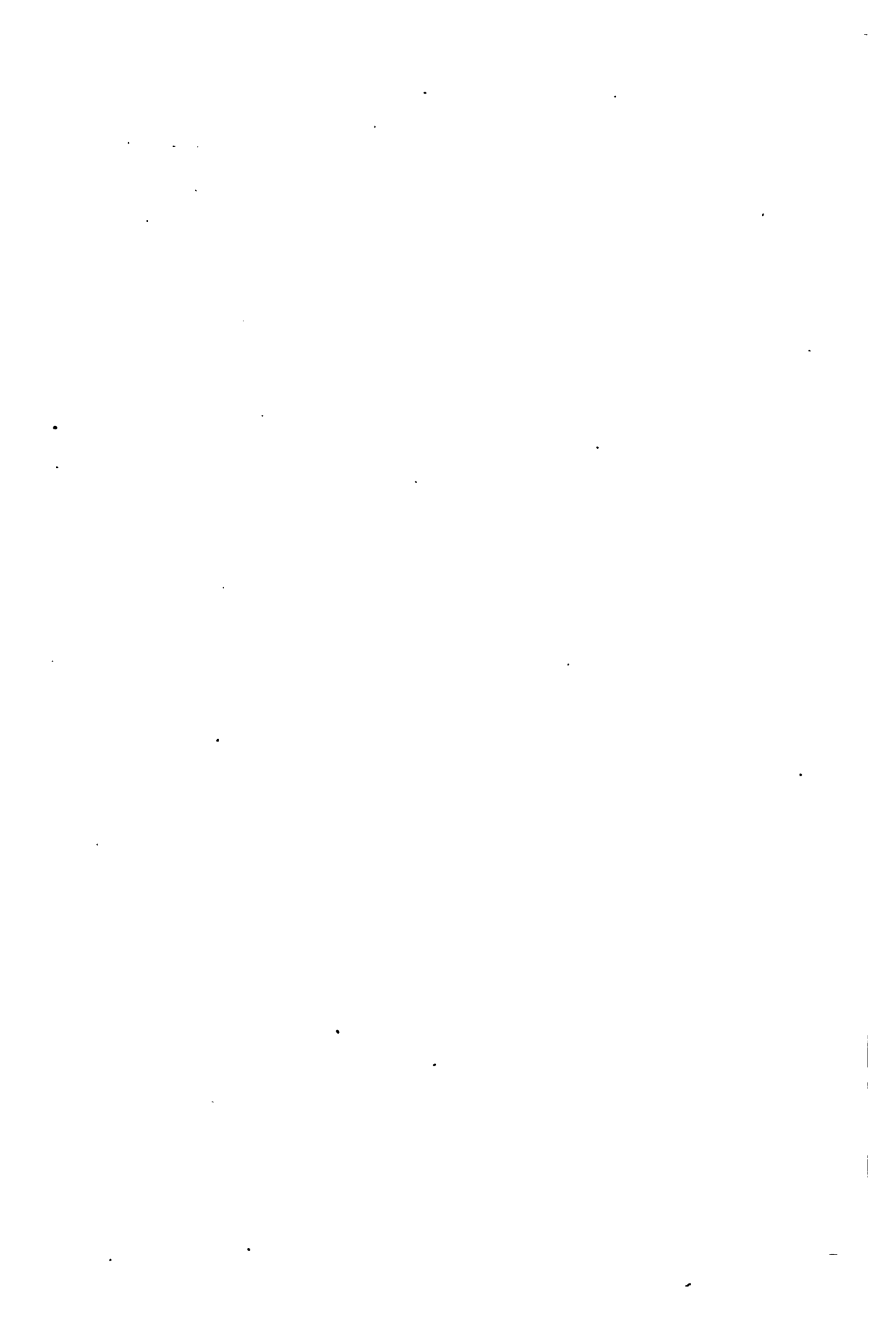


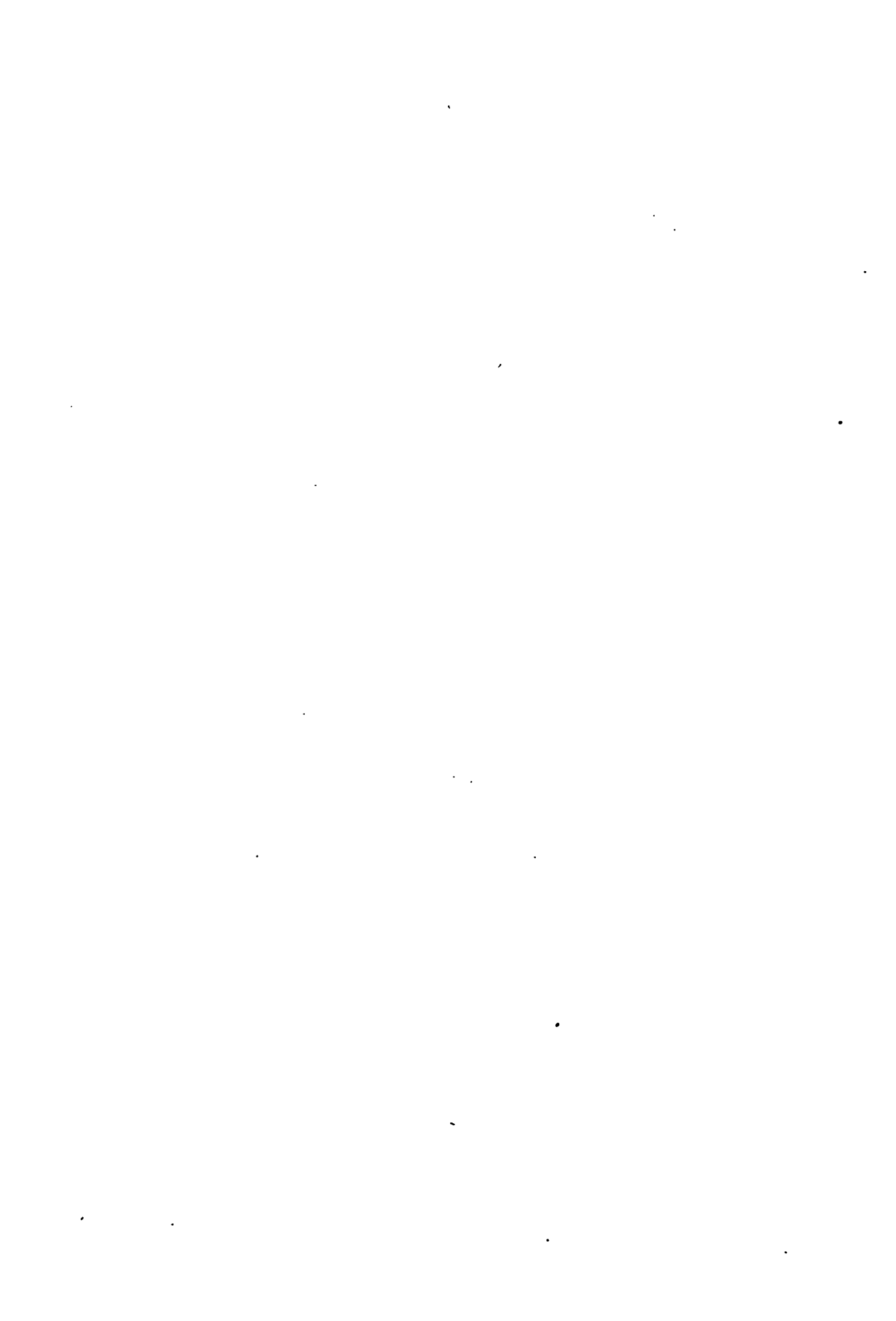








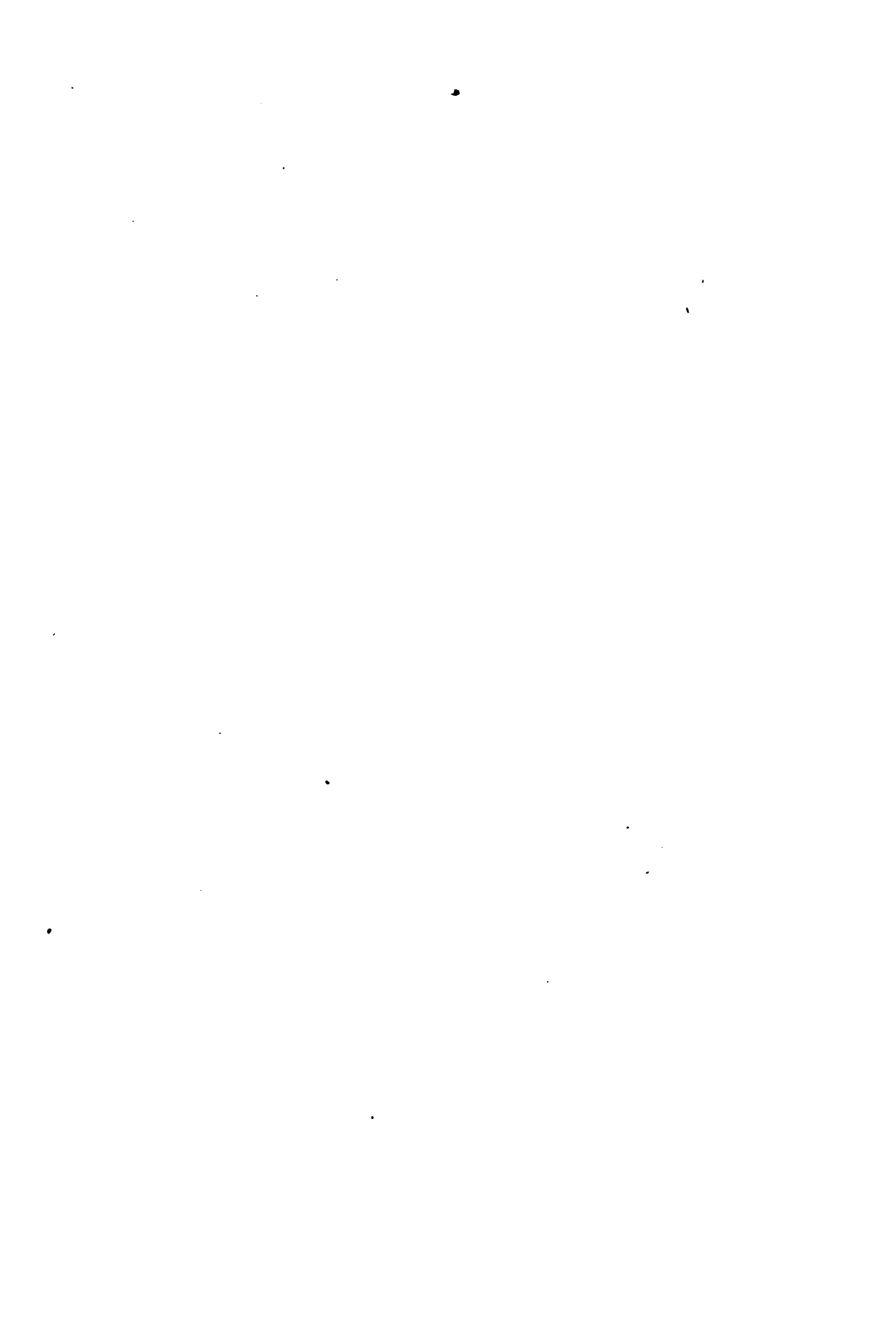






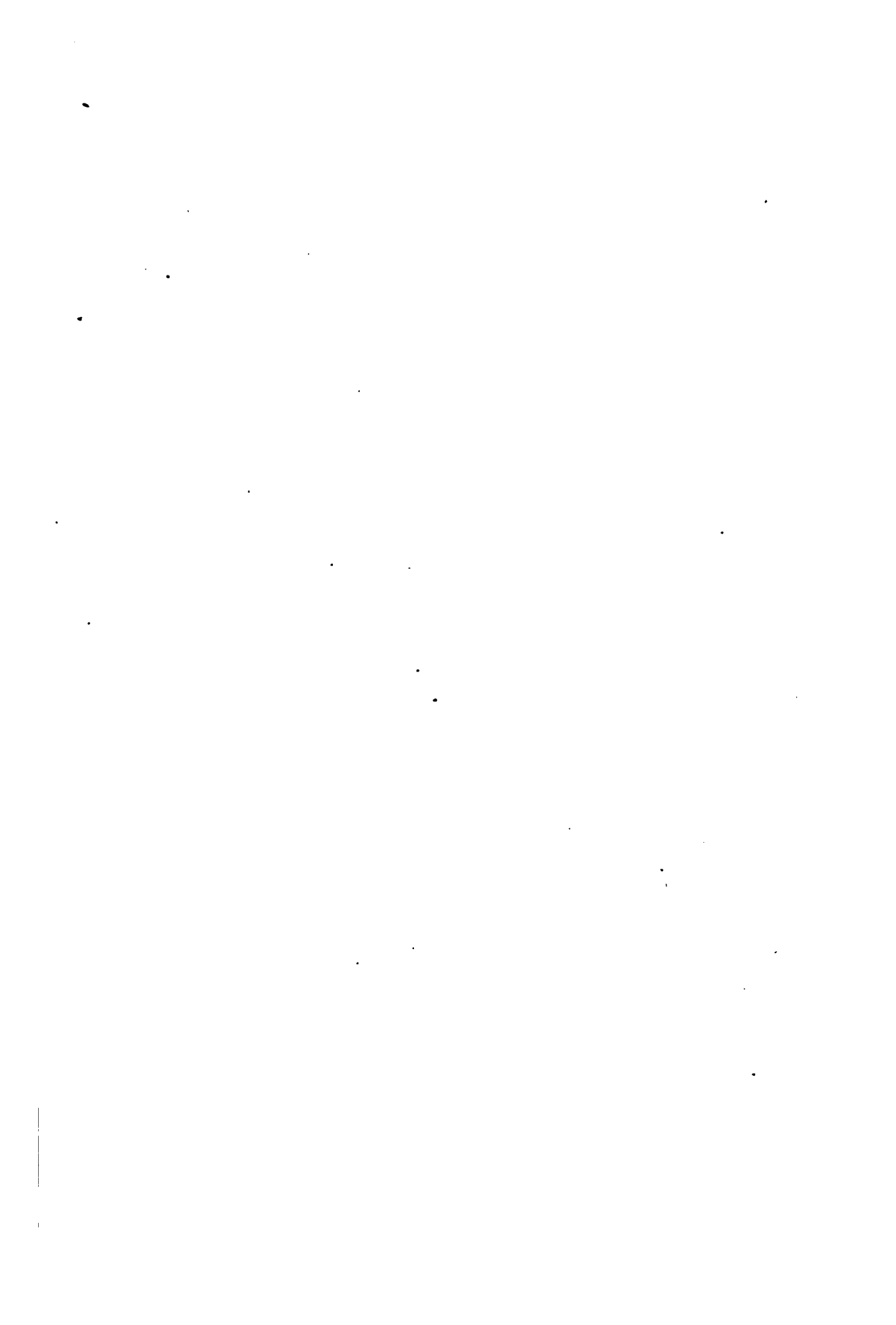


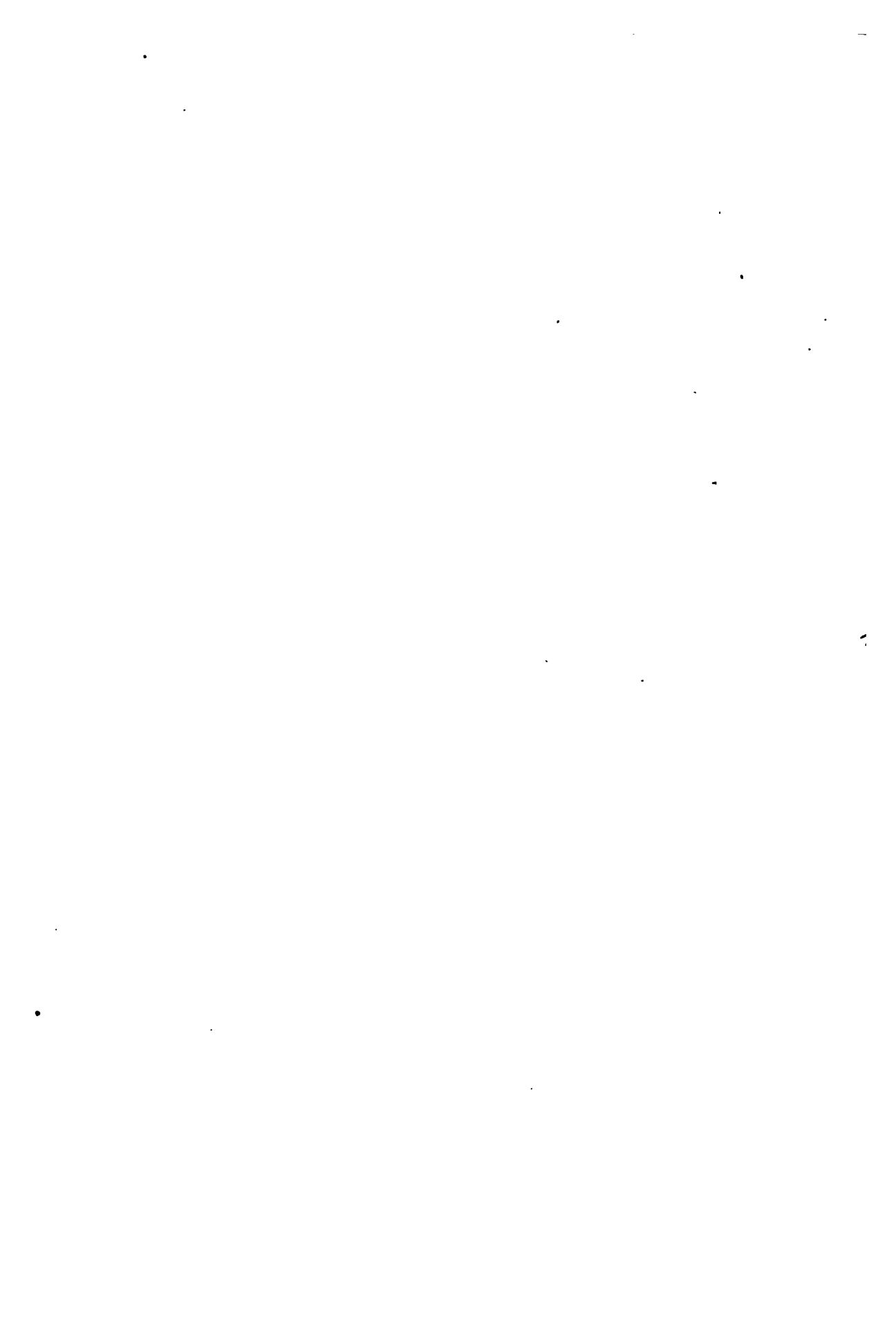


















Applications, stating age, with Testimonials, to be sent before whole time to the Company's business. The Clerk must be a Bachelor, and will be required to devote his Candidates must be between the ages of 30 and 45. The Court of the Company will in the month of November next elect to the OFFICES of CLERK and SURVEYOR.

THE GROORS COMPANY

PROSE, a convert from Hindooism. ANTIVA; and in the Evening by the Rev BHOJANATH Church TO-MORROW in the morning by the Lord Bishop of

S. T. MICHAELS, COORNHILL

Office of the Corporation, 85, Southampton-street, Strand, W.C.

H. I. FLOOT, D.O.L., Secretary. Office to commence at Eleven o'clock. JOHNSON, on behalf of the POOR CLERK'S RELIEF

HIS GRAVE the LORD ARCHBISHOP of

By the Rev. JOHN ROBERTSON, M.A. RUNDAY next, the 12th July, 1885, on ST. STEPHEN, COULHAM-STREET.

will be preached in aid of these schools, in the Church of THE ANNUAL SERMON

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City Press 11/17/85

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NEW YORK
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1911
MAY 11

The Practical Engineer,

ISSUED WEEKLY BY

THE TECHNICAL PUBLISHING CO., LIMITED

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All communications should be addressed to 6, Victoria Street, Manchester; those intended for insertion in the current issue not later than by first post on Tuesday.

Contributors are requested to write on one side only of the sheets. Sketches should be sent on separate sheets.

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Table with 2 columns: Article Title and Page Number. Includes 'Why does Steel Harden and Temper', 'Inverted Vortical Engine', 'The Quillfeldt Petroleum Vapour Engine', etc.

THE

PRACTICAL ENGINEER

OCTOBER 11TH, 1889.

WHY DOES STEEL HARDEN AND TEMPER

relations of carbon and iron, and so many to organic life arose, he thought, from the belief of chemists and operations which involved the use of high temperatures... It could not be that chemists feared to apply to that "science" which was degraded by being applied to vulgar utility, for he trusted that he had shown that matter, which was the object of all research, could be treated in the field of metallurgy as in any other.

started, the draught is sufficient to required for combustion through operation of the casing, as seen in fig. 2.

These little engines are full of ingenuity well worth careful study. Compared with very small steam engines the great advantage, however, is not weight for the power generated. The to be one gallon per hour for a two corresponds to about 4lb. fuel per hour.

For a four-horse engine the average of common petroleum per indicated horsepower engineers expect great advantages for applied to large powers; but, as we have put in these columns, their advantage economy, but in great handiness and proved that if it be attempted to a engines using expansion, failure will an undoubted field for these motors. peculiar qualities are valuable, and engineers who have developed the world.

HARDENING AND TEMPERING

On September 13th, Professor Chandler in St. George's Hall, Newcastle, Tempering of Steel." There was a chair was occupied by the President (Prof. W. H. Flower); and, in addition of the British Association in Newcastle Mayor of Newcastle (Mr. Thomas R. Sir Charles Mark Palmer, Bart., M.P.)

The President said: Ladies and gentlemen on my part to introduce to you any of Chandler Roberts-Austen. He is, as yet metallurgy at the Royal School of Mines Majesty's Mint. In that capacity he is the proper composition of the coins that probably there is no one so well acquainted metals as he is. He is not going to us with which he is so familiar, but about more useful. Without any further introduction Chandler Roberts-Austen to give you that pared this extremely interesting and apparatus.

Professor Roberts-Austen then delivered to the memory of the late Dr. Percy, with literature of metallurgy, and a reference Armstrong's efforts in developing the proceeded to give a brief history of our knowledge and tempering steel. Hardening, he said a highly heated mass of steel. "The in heating this hardened steel to a temperature which it was raised before hardening. The hardening and tempering three sword excellent quality, showing how greatly depended on the treatment they receive over hard snapped under gentle pressure one which was overtempered could remain remained crooked. Professor Austen's vital importance to the nation, Mr. Rust working was the only art "of any at present in England," and that and endurance were written for ever v ment." Notwithstanding the great importance and tempering, the theory of the process such knowledge as we possessed had been shown that in early times great pains believed to be a suitable solution. abstract its heat. Othello's

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ERING OF STEEL.

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the steel was quenched, though their theories were wrong, the degree of rapidity with which heat was abstracted from the cooling steel being as important at the present day as ever it was. Professor Austen then traced the history of the theories relative to the internal condition of steel, pointing out that the work of Bergmann, of Upsala, showed, in 1781, that steel differs from iron only by containing 2-10 to 1½ per cent of carbon. The curious relation between the belief in the existence of phlogiston, and the fight made by the Phlogistic School with that of Lavoisier over the constitution of steel was dealt with at some length, and it was pointed out that the work of Bergmann, though himself a believer in phlogiston, had entirely changed the situation by showing that carbon was the steel-giving element. Clouet did much to prove (1798) that carbon in its diamond form could combine with iron and convert it into steel, a fact which had been confirmed by a working cutler, Mr. H. Pepys, in 1818, and finally by Professor Austen himself, who, for the purpose of the lecture, had heated diamond and carbon together in vacuo, because in all previous experiments a doubt as to the action of gases contained in the iron had existed. Professor Austen then proceeded to consider the mode of existence of carbon in the steel. He showed at great length that, although carbon in any of its forms, graphite, soot, or diamond, could enter into intimate association with iron, the relations of carbon and iron were really very complex. The researches of Karsten, Berthier, and finally, of Sir E. Abel, had shown that in soft steel the carbon exists in the form of a true compound or "carbide" with iron, while in steel which has been hardened by rapid cooling the carbon is "dissolved," and not truly combined; in "tempering," or softening steel, another change in the relation of the carbon and iron being effected, the degree of hardness depending mainly on the relations subsisting between the carbon and the iron, although the state of the carbon did not explain all the facts of hardening and tempering. The next portion of the subject was one of great difficulty. Professor Austen gave full reasons for the belief that iron itself can exist in more than one state. For instance, carbon may be equally pure carbon, either in the diamond or sooty form; sulphur equally pure sulphur either in a form which is soft and pliable at ordinary temperatures or in the hard, yellow form with which we are all familiar with it; the soft passing instantaneously into the hard variety with evolution of heat. In the same way there is strong reason to believe that at a red heat the molecules of iron are really hard. If pure iron be cooled either quickly or slowly, it passes into the soft modification, but if carbon be present, and the metal be quickly cooled, it has no time to pass to the soft modification, the presence of the carbon hindering its passage, and hard steel being the result. Bearing in mind that evolution or absorption of heat is the surest indication of molecular change in the element, Professor Austen gave experimental evidence of the existence of molecular change in iron. One experiment was very curious. A red hot bar was taken from the furnace gripped only at one end, while a weight was attached to the other. The bar did not bend when being in its hottest state, it might have been expected to be soft, but it fell 6in. as soon as the point of molecular weakness came, the iron being comparatively cold. Prof. Austen showed how important the action of small quantities of matter on masses of metal really is, pointing out that this appeared to be a broad principle of nature, one recognised by the alchemists, and still employed by metallurgists, who marvel daily at the extraordinary effect which would be produced in iron by quite small doses of sulphur, phosphorus, chromium, or aluminium. Professor Austen said that he was not afraid of the taunt of Francis Bacon that "sottishly do the chymics appropriate the fancies of poets to the transformation of bodies to the experiments of their furnaces," for although metals could not be transmuted, they could be transformed, by very slight influences, so as to behave, from the point of view of special work demanded from them, either beneficially or prejudicially. He concluded by pointing to the importance of hardening and tempering in relation to all kinds of steel. In the early days when steel was substituted for iron, it was viewed with suspicion, mainly because the fact that iron could exist in two distinct molecular states was ignored. He showed that the material of which the Forth Bridge is made owes its substantiality to the fact that while being very strong, it is very soft and ductile, and will not harden energetically. The enormous importance of the substitution of steel for iron was shown by the figures supplied by Mr. Webb, of Crewe, who stated that on the entire system of the London and North-Western Railway eighteen tons of steel disappeared daily by oxidation and wear. With regard to highly carbonised steels it was shown that a properly tempered die would strike 40,000 coins, while one which had been over-hardened would probably fracture with the first coin it attempted to strike. In conclusion Prof. Austen said it was shown that a few

which metal had within the last quarter of a century been gradually usurping the position that was formerly occupied by wrought iron, had been conducted to very good purpose. When they considered the difference of manufacture, and the difference of product there between wrought iron made by the puddling process, and then uni- more or less perfectly by welding, and the steel made by some process involving fusion, and then forged in the ingot state, he thought they would all agree they had now to deal—and their successors would have to deal—with a material which, for almost all engineering purposes, was far and away superior to the wrought iron with which their forefathers had to be content. If this were true of the metal itself—as it certainly was—the question as to the treatment of this most valuable new metal—for new it was—in the wholesale manner in which it was produced and used—the manner in which this new metal should be treated as regarded its hardening and tempering was of the highest importance, it was true that, except in certain particular manufactures, large masses of steel were not, as a rule, hardened and tempered, but there was one manufacture, and one which was the prominent manufacture of this city—that of artillery—wherein large masses of steel were dealt with to be oil-hardened, as it was called, and afterwards dealt with in the way of annealing, if not in the way of tempering. It was true they succeeded in them, but they succeeded by reason of the experience of the men who had been devoted to the manufacture all their lives, who knew what to do, and knew what would result, but could not tell why it would result; and it was to the labours of men like Professor Roberts-Austen, who endeavoured to investigate the cause of these effects obtained, that they looked forward to the certainty in manufacture which at present did not exist, our dependence at the present time being, as he had said, upon the experience, instead of being, as he hoped it would be, upon the application to the manufacture of well-known principles, as they applied scientific principles in other cases. But hitherto there was no doubt that the question of hardening and tempering steel had been truly a mystery, and he thought that no one more readily than the lecturer, who had interested and instructed them so much, would agree that it was still a mystery, and that those men who devoted themselves to solving those mysteries deserved well of their fellow countrymen and of the world at large. There was one use of steel of which they were told, where he expected it would be extremely difficult even for the most profound chemist to tell them how to temper it. Eighteen tons of steel used daily for pens! What chemist could tell them how to temper them? But he thought as regarded the steel to be used in the more innocent purpose of making weapons of destruction the researches which had been made, and which would yet be made, were and would be of the greatest importance.

Captain Noble seconded the vote of thanks. He said the lecturer had called the attention to the very great importance of steel. To few places, perhaps, was it of greater importance than to Newcastle, where so much of the prosperity of Tyne-side was connected with industries dependent upon its use. Professor Roberts-Austen had said that that a revolution had taken place during the last 26 years since the British Association was last in Newcastle. He could entirely confirm that statement. In the works with which he was connected, making a guess, he supposed that 26 years ago, of the iron they used not more than 10 per cent was used in the form of steel, and about 90 per cent in the form of iron. He did not suppose he was very far wrong in making a guess that those proportions were about reversed. But if they were to keep pre-eminence as ironworkers, which Mr. Ruakin good enough to allow them, it could only be done by following searches in the spirit which Mr. Roberts-Austen has shown to that night, and in the spirit in which that association, which honours them by being present, had done so much to encourage them and to foster.

The vote of thanks having been passed, the proceedings ended.

OCKER
OCT 18 1989

